# McGRAW-HILL DIGEST


ION EXCHANGE—NEW TOOL—Report to Management...50

## SPECIAL FEATURES

Gas Turbines in Industry.... 8
Japan—Far Eastern Workshop 10
Impact of Petro-Chemicals..12
Continuous Mining-Loading.18
Food-Factory Efficiency.....23
Eyes Measure Cotton Quality.26
Modern Fertilizer Process....28
Technical Shorts .....32
Causes of Electrical Fires....34
What's New in Aircraft.....39
New Products .....42
Flotation Recovers Waste Fuel 46

### AVIATION

Turbojet Details Revealed....12
New Supersonic Planes.....31
Make Flying Safer.....36
Also: 15, 30, 32, 39, 41, 42, 44, 45

### CHEMISTRY

Vinyl Acetate Process.....14
Sewage Plant Sells Sludge...19
Five Products from Bark.....38
Also: 12, 24, 27, 28, 32, 37, 42, 44

### CONSTRUCTION

Dam Ingenuity .....16
Earth Used to Build Houses...25
New Machine Repairs Roads..27
Also: 11, 17, 22, 26, 32, 42, 44, 48

### ELECTRICITY, POWER

Quick Turbine Start-up.....30
Boilers Need Waterwalls.....47
Model School Lighting.....48
Also: 19, 21, 24, 32, 34, 38, 42, 44

### ELECTRONICS, RADIO

Million Words a Minute.....14
Printed Circuits Practical.....48
Ultrasonic Laundering .....49
Also: 13, 22, 27, 32, 35, 38, 43, 49

### FACTORY METHODS

Factory Saves Labor.....13
Operators Buy Machines.....15
Filing Becomes Specialty.....49
Also: 10, 21, 25, 28, 31, 32, 34, 37

### FOOD PROCESSING

Edible Meat Casing.....15
New Food Technology.....20
Speeds Food Service.....22
Also: 10, 23, 32, 33, 42, 43, 45, 48

### MECHANICAL DESIGN

Powerful Little Tool.....25
Saves Assembly Time.....40
Designed for Service.....48
Also: 19, 22, 24, 33, 42, 43, 45, 47

### METALWORKING

Germans Extrude Cold Steel..20
Transfer Presses Efficient.....21
More Accurate Press.....31
Steel Beer Barrels.....40
Also: 10, 19, 32, 33, 41, 42, 44, 45

### MINING

New in Russian Mining.....35
Undercast Aids Safety.....36
Reduces Mine Power Loss....41
Also: 10, 18, 32, 33, 38, 43, 46, 49

### TEXTILES

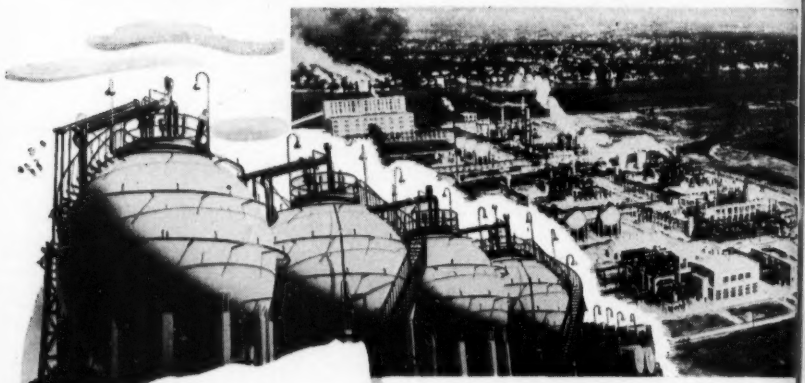
Fast Wool Handling.....15
Continuous Bleaching .....35
Controls Shrinkage .....36
Also: 10, 26, 30, 32, 33, 43, 48

### TRANSPORTATION

Fast River Transport.....13
Bus That Bends.....14
Aluminum Railway Car.....41
Also: 10, 20, 34, 36, 40, 45


*172 ITEMS IN THIS ISSUE*

# SYNTHETICS AN EXAMPLE OF CANADIAN INDUSTRIAL VERSATILITY . . .



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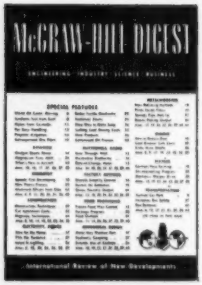


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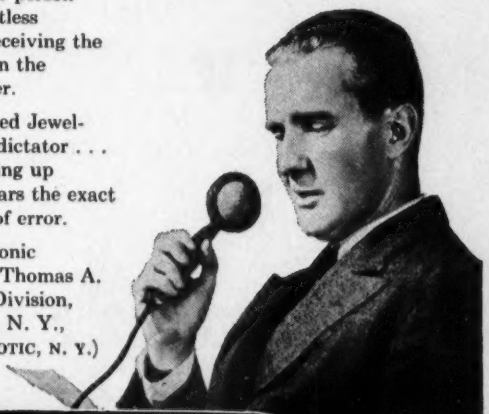

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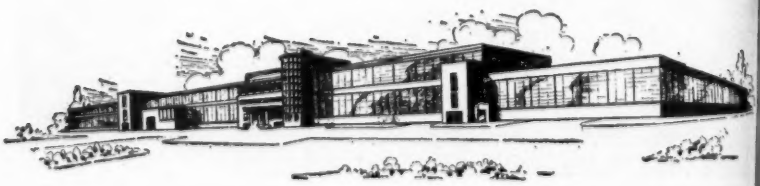

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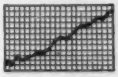
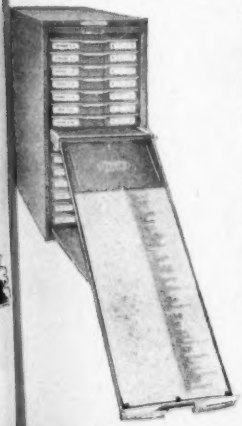


*3...Assures a controlled stock of quick-selling items needed to get —and hold—day-to-day business from important customers.*



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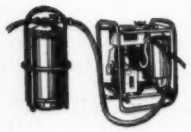

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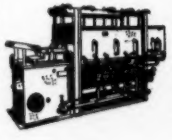

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WAA is the world's greatest source of industrial equipment—offering a varied assortment of needed items at "below market" prices.

On these pages are shown only a few of the many thousands of items for sale. Instruct your U. S. buying agent to find out what else is being offered—then act immediately on his information. He knows how and where to buy but will need your authorization to make appropriate inspection and arrange for export shipment.

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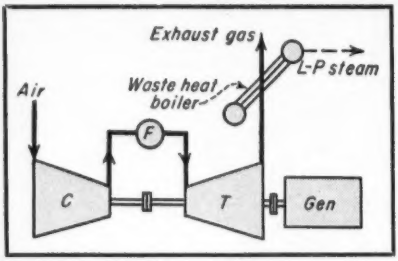
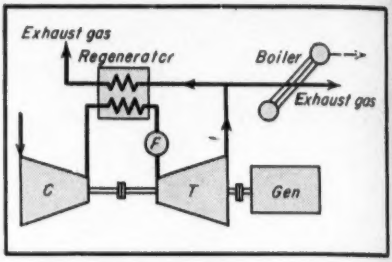
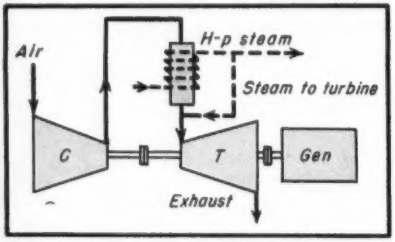


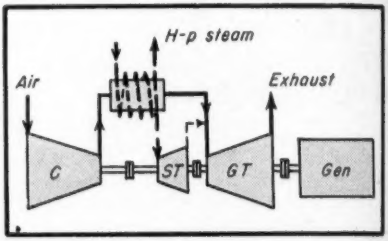

**1** SIMPLE-CYCLE gas-turbine plant producing low-pressure steam from exhaust gas in the waste-boiler.



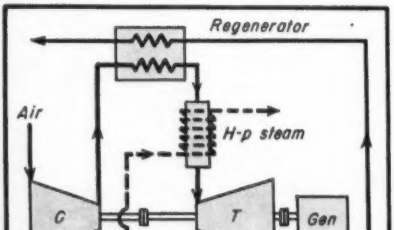

**2** REGENERATIVE-CYCLE gas-turbine plant can use waste-heat boiler in parallel with the unit's regenerator.

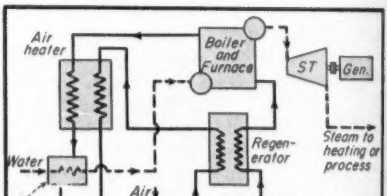



**5** PART of high-pressure-steam output can be throttled and passed through turbine to increase the total shaft power.



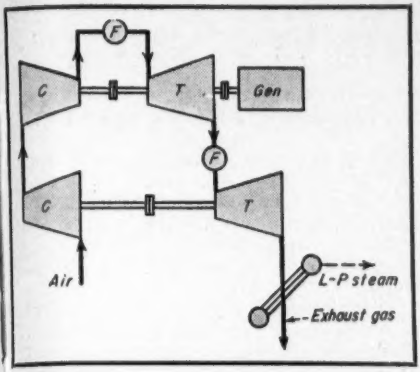

**6** TO UTILIZE high-pressure steam efficiently for shaft power production it can first be passed through turbine on shaft.

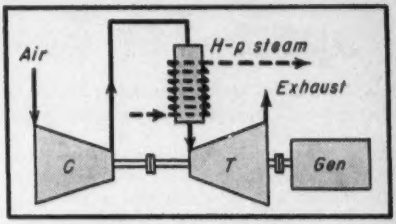



**8** SCHEME combines air turbine with conventional steam-boiler plant to increase relative output of electrical energy.

**7** SOME of exhaust can be diverted as needed from regenerator to preheat feed water in an economizer. (Left)




**4** SIMPLE-CYCLE gas-turbine plant with high-pressure-steam generating surface provided in the furnace.

**3** TWO-SHAFT reheat-cycle plant can also use waste-heat boiler. (Left)

# Gas Turbines for Industry

**May be used in several ways to produce process steam as well as power. Also useful as air compressors for blast furnaces and chemical processes**

In industrial applications, the power plant usually must supply process heat as well as mechanical or electrical energy. Comparatively little has been done to explore the possibilities of the gas turbine for such use, but it seems likely to occupy a place somewhat between the steam-turbine (very flexible power-heat ratio) and the diesel engine (limited heat capacity).

Several different gas-turbine industrial-plant hookups are illustrated in the diagrams. Exhaustive analysis has not established fully their practical and economic feasibility. It is believed, however, that they indicate worthwhile possibilities and should be studied further by power engineers.

**Pressure-reducing Turbines** — Where gas is available at relatively high pressure, as in gas fields, power can be obtained simply and cheaply by expanding the gas through a turbine, without either combustion or compression.

**Houdry Process**—The gas turbine found early use commercially in the Houdry catalytic refining process. Air used to regenerate the catalyst picks up heat. Exhaust from the catalyst chambers expands in a turbine, generating sufficient power to drive the compressor and furnish some electrical energy as a dividend. More than 30 units have been applied in refineries.

**Blast Furnaces**—Another field for the gas turbine as a compressed-air producer is in blast-furnace blowing. The compressor supplying the air for the turbine also supplies blast air, making a separate blower unnecessary. Where lower blast temperatures permit use of a steel blast heater in place of a Cowper stove, considerable space can be saved and higher efficiency obtained. Gas for turbine and blast both are heated with products of combustion of a single combustion chamber.

**Chemical Processes**—In view of the tendency to speed reaction time of chemical processes by supercharging, other possibilities for the gas turbine as a compressor will develop. —POWER

# Japan—Far Eastern Workshop

**Country's economy rests upon her ability to export. Many raw materials necessary to maintain production. Finished silk to be main export item**

Key to Japan's economic future—and that of the Orient, too—lies in the country's ability to produce and export materials from its vast industrial setup. Despite 30% damage during the war, Japan is the Orient's biggest producer. Her ability to manufacture for export will depend upon her ability to import such currently short commodities as coking coal, iron ore, pig iron, crude petroleum, nonferrous metals, rubber, salt, and wood pulp. She also is short of indigenous cotton, wool, hemp, and jute.

The long-range program of the Economic & Scientific Section, Allied Command, set up at Potsdam, now is modified to include: elimination of Japan's war potential; maintenance of a minimum living standard; continuation of the importance of Japan's industry to the entire Far East; and prevention of the spread of Communism.

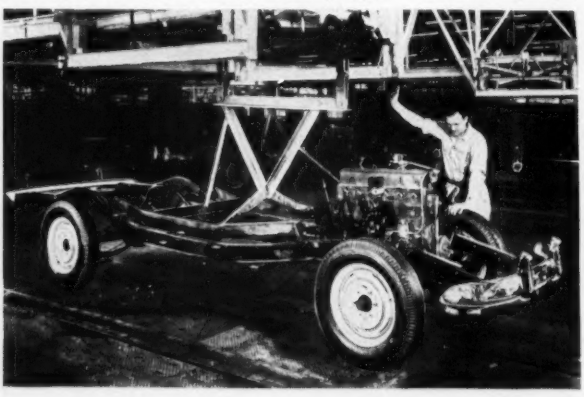
Primary considerations are the need for food and clothing. In the 1930–34 period, Japan annually used 14,000,000 metric tons of cereals; 4,500,000 tons of potatoes; 1,200,000 tons of beans; 800,000 tons of sugar. Currently, she should produce all her needs, except for sugar and 2,000,000 tons of cereals. During the 1930-34 period, 2,000,000,000 sq. yd. of cloth was needed to clothe the Japanese; requirements now are 2,400,000,000 sq. yd.

It is planned to replace domestic use of silk with rayon, the silk to be exported. Necessary imports for rayon manufacture will be 520,000,000 lb. of raw cotton; 210,000,000 lb. of raw wool will be needed as imports to fill domestic consumption.

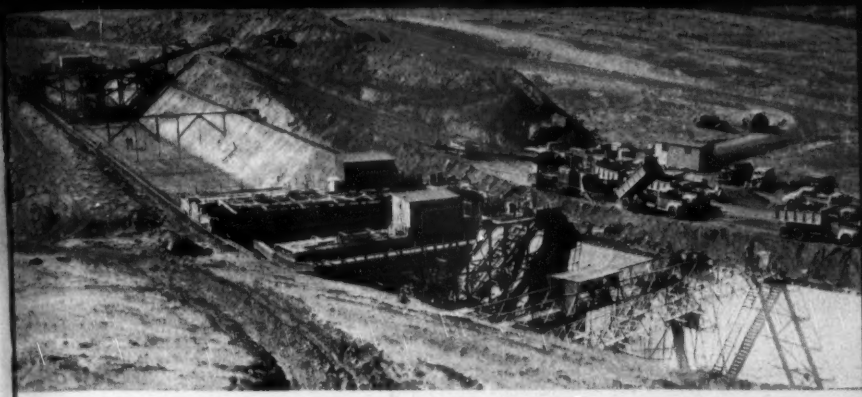
Group by group, Japanese industry of the future looks about as follows:

**Textiles**—During the 1930-34 base period, silk represented 60% of Japan's exports. Silk will remain the largest single item of export, but will be exported as finished silk rather than raw yarn. Rayon production will jump 150% to 900,000,000 sq. yd. annually, wool 20% to 320,000,000 sq. yd.

**Machinery**—Even after reparations, the country will be able to supply her



OVERHEAD SUSPENSION—In Chevrolet plant, most of the 4½ miles of assembly conveyors will be overhead monorails, permitting work at bench level and freedom on all sides. A "power-and-free" system loops power chain away from rail at intervals. At these points, operators can hold work to catch up, or can shove it through. Line handles 80 units per hr.
—BUSINESS WEEK



**FAST CANAL FINISHING**—Train of self-propelled canal-building equipment moves down rough excavation of 85-ft. Friant-Kern Canal, leaving finished lining in its wake. Shaped to canal cross section and riding tracks on either side, equipment includes (l. to r.) subgrade trimmer, water-spray jumbo, concrete liner, expansion-joint cutter, joint calker, and spray-curing jumbo. Hydraulic jacks at truck supports raise or lower rigs to adjust trim depth or thickness of concrete lining. Trimmer is bucket-type excavator. Lining machine—a slipform rig—places, vibrates, and screeds concrete. Concrete is mixed in paver operating along top of canal. —CONSTRUCTION METHODS

domestic needs in machinery, with a surplus for export. After reparations, capacity will be 27,000 units annually, about half the capacity being required domestically. Japan will produce 1,000 locomotives and 19,000 freight and passenger cars per year; she will use about 25% of this production.

**Chemicals**—Part of the country's sulphuric acid, caustic soda, chlorine, and soda ash capacity will be taken as reparations. Her remaining chemical facilities will produce 1,400,000 tons of ammonium sulphate; 500,000 tons of superphosphate; 4,000,000 tons of sulphuric acid; 460,000 tons of caustic soda; 650,000 tons of soda ash; and 70,000 tons of chlorine annually. This more than fulfills domestic demand. Exports of chemical fertilizers, especially ammonium sulphate, can be expected.

**Metals**—Production capacities will be restricted to 1,750,000 tons of pig iron; 2,250,000 tons of steel; 100,000 tons of copper; 40,000 tons of zinc; 15,000 tons of lead; and 750 tons of tin annually. Additional requirements in pig iron, zinc, lead, and tin will be imported; pig iron needs will reach 500,000 tons.

**Mining**—Production in all ores except iron ore is sufficient to meet demand. Coal is the tight commodity. Output of coal may reach 36,000,000 tons annually, but 40,000,000 tons may be required to fill demand .

**Others**—Salt production at 600,000 tons annually will meet about one-third of the demand. Lumber is sufficient, but pulp production will fall 600,000 to 700,000 tons short of demand. About 1,000,000 tons of the annual cement production of 8,000,000 tons will be exportable.

Prior to war, about 50% of Japan's exports were to Asiatic countries. This figure must jump to 75%, for the Far East can pay for Japanese production with commodities needed in the island country's economy. Currently, production is about 40% of 1930-34 figure, and with the exception of two months, the rise in production rate has been a steady 16%. —BUSINESS WEEK

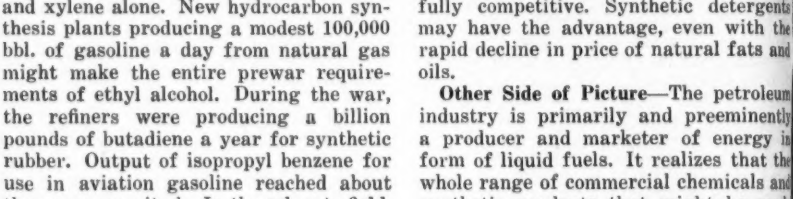
# Impact of Petro-Chemicals

**Petroleum refiners have entered chemical manufacturer's field on a big scale, but are seen as raw materials suppliers rather than competitors**

Does large-scale entry of petroleum refiners into field of the chemical manufacturers presage destructive competition or a constructive service as a boundless source of raw materials?

The oil industry is a potential source of 85 billion pounds of benzene, toluene, and xylene alone. New hydrocarbon synthesis plants producing a modest 100,000 bbl. of gasoline a day from natural gas might make the entire prewar requirements of ethyl alcohol. During the war, the refiners were producing a billion pounds of butadiene a year for synthetic rubber. Output of isopropyl benzene for use in aviation gasoline reached about the same magnitude. In the solvents field, petroleum and natural gas today account for 5% of the U. S. methanol production, half of the ethyl alcohol, all of the isopropyl alcohol, 75% of the acetone, 35% of normal butyl alcohol, and 90% of the amyl alcohol. The major part of the xylene supply comes from petroleum. Large quantities of acetic anhydride and acetic acid trace their origin to petroleum. Toluol no longer is a coal-tar monopoly. A greatly increased output of benzol is near at hand. Cresylic acids are fully competitive. Synthetic detergents may have the advantage, even with the rapid decline in price of natural fats and oils.

**Other Side of Picture**—The petroleum industry is primarily and preeminently a producer and marketer of energy in form of liquid fuels. It realizes that the whole range of commercial chemicals and synthetic products that might be made from petroleum could utilize only a fraction of 1% of the world's crude oil production. By and large, it is not set up to deal in highly refined specialties. It makes money on large-volume, low-mar-




**TURBOJET DETAILS REVEALED**—Engineering information about the widely used TG-180 turbojet developed by General Electric has been published for first time. This schematic flow diagram shows high degree of inside and outside streamlining and principal parts. Axial flow compressor consists of 11 bladed-disks shrunk on steel shaft and enclosed in aluminum casing. First 10 disks are machined from aluminum forgings; 11th is heat-treated steel forging. Split compressor casing (stator) is used; blades are forged and coined to size. Combustion chambers (8) have removable liners; during combustion, some compressor air is admitted at liner dome, balance is fed through holes and louvers in sides, reducing hot gas to 1,500°F. temperature. Turbine is single-stage impulse type, blades being heat-resistant alloy. Turbine wheel is air cooled. Axial thrust on main rotor assembly is balanced by air. —AVIATION WEEK

FAST RIVER TRANSPORT—Carrying 600 automobiles, this 16-mph., fast-loading river barge is three vessels joined together. Three 600-hp. units of four diesels power it. Vessel can be loaded in 4 hr. Commercial Barge Lines is operator. —BUSINESS WEEK

gin products. It sees no percentage in selling expensively purified hydrocarbons at the price of gasoline. Its technology changes so rapidly that it is reluctant to enter into long-term contracts demanded by chemical customers. It has no desire to build up substantial inventories of chemical raw materials that must be held for relatively long periods. Finally, very substantial chemical engineering problems are yet to be solved in making some of these materials available to chemical manufacturers in usable form. This applies particularly to the relatively large quantities of oxygenated compounds currently produced in the Fisher-Tropsch process of making liquid fuels from natural gas.

H. W. Fisher, president of Enjay, Inc. —subsidiary of Standard Oil Co. (N. J.) —sizes up the petro-chemical situation as follows: "We do not think of the activities of the petroleum industry as being in conflict with those of the chemical manufacturer, but rather as a relationship between raw material supplier and consumer . . . " —CHEMICAL ENGRG.

## ELECTRONS STOP LIFE

If beams of high-voltage electrons produced by a capacitron are passed through living animal or vegetable tissue, the life process in the tissue is interrupted. The technique may be useful in preserving food products or in the treatment of cancer. —ELECTRONICS

## FACTORY SAVES LABOR AND ELEVATOR TIME

Saving of 700 elevator hours and 14,000 man-hours per year resulted at Stewart-Warner Corp. through modernized layout and mechanized handling. All production work is now on one floor rather than the previous six.

Machine fittings are stored in master hoppers, which are numbered according to the next operation station number. Control board indicates, by means of lights, the work stations which are in need of supply. Attendant fills traveling hoppers from numbered bins, hoppers being carried to work area by conveyor. Lug on side of hopper is engaged as it passes over designated chute, then chute-feeding machine raises and load is dumped. When chute is filled, light on control board goes out.

As parts are completed, they are inspected electromagnetically, accepted parts being drained of lubricant and deposited in mobile hopper. Hopper is moved to a lift, raised, and contents dropped by chute into wire baskets. Baskets are picked up by overhead conveyor and carried to degreasing and drying stations. Following the drying operation, baskets are dumped into bins for heat treating.

Assembly machines are automatically fed, assembled parts being ejected by air into hoppers for transportation to weighing stations. —FACTORY

BUS THAT BENDS—58-passenger Twin Coach bus gives smooth riding around corners and over bumps. Rear wheels can track front wheels, and rubber "hip" enables rear section to follow dips in road. "Torsilastic" rubber mounts connect sections. —BUS TRANSPORTATION

## MODERN GERMAN PROCESS FOR VINYL ACETATE

In modern vinyl acetate plant at Hoechst a/Main, Germany, the catalytic vapor-phase process is used. Catalyst consists of activated charcoal impregnated with solution of zinc acetate.

The catalyst is held between vertical plates, and catalyst bed is kept cool by water flowing through tubes. Gases pass downward through the catalyst, and one 490-cu. ft. charge lasts about 2 months, with vinyl acetate produced at rate of 400 to 500 metric tons a month.

Acetylene for process is generated from calcium carbide, scrubbed with sulphuric acid, and passed over potassium dichromate and kieselguhr. Purified acetylene is bubbled through 60°C. acetic acid, is heated to 170°C., then passed into catalyzer.

Crude vinyl acetate vapor from catalyzer passes through heat exchanger, carbon dust separator, condensers, and a still. —CHEMICAL ENRGR.

## SCIENTIFIC MYSTERY

Ordinary compressed air is converted into both hot and cold air by a 15-in. long, 1-in. dia. pipe. The air enters one end of pipe through a nozzle, strikes pipe wall on a tangent, and becomes a whirlpool. Air in center becomes cold almost instantly, while that on periphery gets warm. Cold air is drawn from ¾-in. opening at center of one end; warm air is tapped from periphery.

Scientists have no explanation, but conjecture that cause may be frictional effect between gases moving at different velocities. —POWE

## MILLION WORDS A MINUTE

Described as "television used for communications," the new RCA Ultrafax system will transmit 1,000,000 words a min. A complete printed or written page is handled as a single frame of a television image and is separately photographed at receiving end.

The television band is wide enough to handle 108,000 complete facsimile pages per hour. —ELECTRONICS

## NEW FOR THE HOME

Consisting of a soap retainer and two water spouts clamped on kitchen water fixture, the Caldwell Noel Corp. dish washer permits washing and rinsing in the same operations. Unit is fed through rubber hose. One water spout ejects soapy water, the other clear water. The die-cast aluminum fixture is finished in polished colored enamel. . . . To prevent kitchen heat from escaping through ventilator fan when not in use, Westinghouse Electric Corp. has engineered a new ventilator with an insulated outside door. Unhooking chain to door opens door and starts fan. —BUSINESS WEE

## OPERATORS BUY MACHINES AND BID ON WORK

When material and labor costs began to rise rapidly, Market Specialties Co. invited its employees to become machine owners and members of the firm. Under the operator-owner plan, machine owners bid, competitively on jobs. Management adds cost of material and overhead to bid fixing selling price. Payment to operator is on basis of bid received.

Operators set their own hours, can hire others to do overtime work. Operator wishing to buy machine is screened by top management, then by operator-owners. Before plan was instituted, operators earned $1.50 per hr.; now pay for these workers ranges from $2 to $2.50 per hr. —BUSINESS WEEK

## AIRPORT VISIBILITY METER

To eliminate or reduce the human factor in measuring visibility at airports, National Bureau of Standards has developed an electronic instrument. This transmissometer measures accurately and continuously the light transmission between two fixed points 400 to 4,000 ft. apart. Light source is a 6-volt sealed-reflector lamp of 350,000 candlepower. Receiver consists of a lens, diaphragm, photo-pulse unit, and amplifier. Frequency of pulses, directly proportional to light intensity, is shown on an indicator consisting of a two-stage amplifier, a frequency-measuring bridge, and a calibrator. —ELECTRONICS

## EDIBLE MEAT CASING

Made from citrus-peel or apple-pomace pectin, a new coating material for sausage or other molded meat products is a digestible, tender material. It dissolves upon boiling, practically disappears upon frying or roasting.

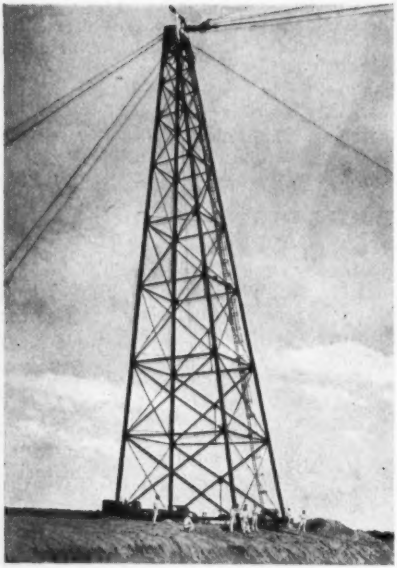
To make the coating material, a 2% dispersion of low-methoxyl pectin is prepared and adjusted for acidity. Then a calcium salt is added to form calcium pectinate at about 158°F. The material gels upon cooling to 104°F.

Molded meat product is dipped into solution for about 3 sec., and coating is dried in a warm air current for 30 min. to form film of good strength. Western Regional Research Lab. developed material. —FOOD INDUSTRIES

FAST WOOL HANDLING — Used to spread wool evenly within bins as it is dropped from sorting room above, and to load wool onto trucks, this grapple-equipped crane handles up to 20,000 lb. per hr. Crane travels entire length of bin on tracks attached to wall or posts close to ceiling. Power is supplied by an enclosed electric feed rail parallel to the track. —TEXTILE WORLD

# Dam Ingenuity

**At Fall River Dam, concrete is placed by 1,500-ft. 15-ton highline cableway with unique rocking tail tower and traveling head tower. Rocking avoids leg tension. —Construction Methods**



TOWER ROCKS—This 150-ft. fixed tail tower on cableway eliminates tension in its legs by permitting them to lift off bases with shifts in loading. Nuts on anchor bolts are 6 in. above base plates. Actually, movement rarely exceeds 2 in.

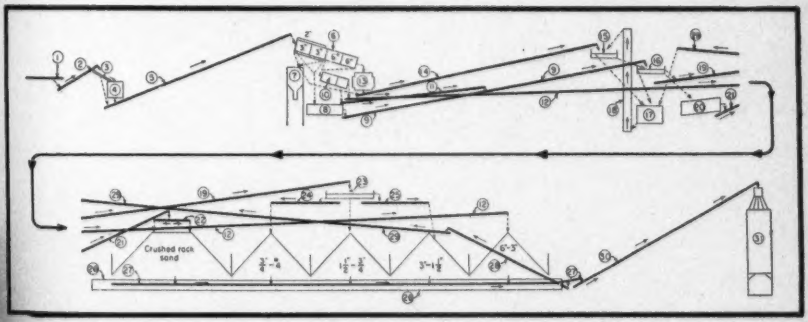
LIKE THIS—Battered front leg of tail tower kicks up 1 in. as backstays pull tower backwards when load is released from main gut line. As head tower (below) travels past centerline, corresponding opposite backstay takes more of the load.

TOWER TRAVELS—Head tower travels on curved double tracks, with all four rails at same level. Straight track at right is for flatcar which transfers concrete buckets from nearby central mixing plant to cableway. The 100-ft. tower is guyed to heavy concrete counterweight. To distribute heavy weight and toe thrust over tracks, front and back pairs of legs each are carried by double 12-wheel trucks.

LAYOUT OF PLANT—Complete sand and stone preparation unit. See flow sheet below.

# Latest in Aggregate Plants

**Modern and elaborate plant erected on job produced all aggregate for concrete spillway section of Fall River Dam.—Construction Methods**



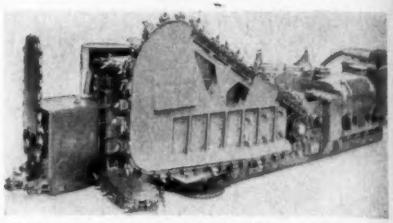

FLOW SHEET—Movement of material through various processes is diagrammed here. (1) Truck dump. (2) Apron feeder. (3) Bar grizzly. (4) Jaw crusher. (5) Main feed belt, 158 ft. (6) Rotary scalping screen. (7) Road aggregate bin. (8) Log washer. (9) Conveyor. (10) Rotary rinsing screen. (11) Reclaimer belt. (12) Conveyor. (13) Rotary crusher. (14) Conveyor. (15) Washing screen. (16) Double-deck screen. (17) Sand roll. (18) Elevator. (19) Conveyor. (20) Sand classifier. (21) Sand conveyor. (22) Reversible shuttle belt. (23) Double-deck screen. (24) Conveyor. (25) Conveyor. (26) Reclaiming tunnel. (27) Reclaiming belt. (28) Return conveyor. (29) Return conveyor, second flight. (30) Main feed conveyor to concrete plant. (31) Concrete plant.

# Continuous Mining-Loading

**Next labor-saving step is elimination of multiplicity in equipment through use of single machine; will bring cheaper coal. Three such machines developed**

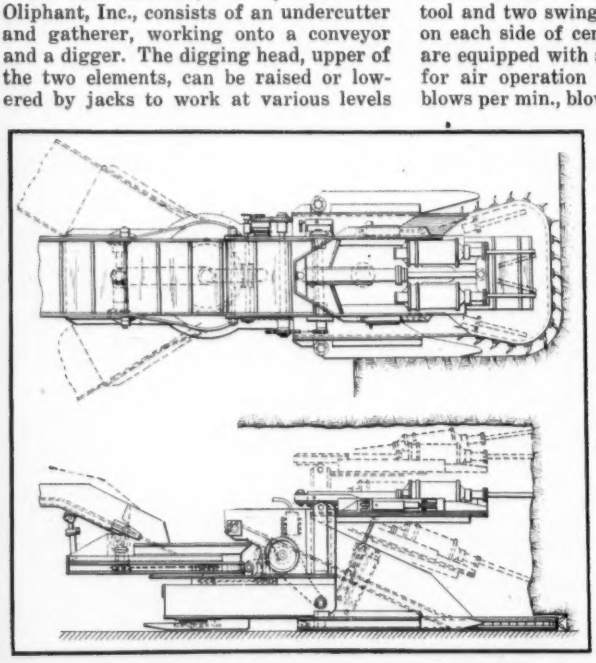
Continuous mining and loading, without cutting, drilling, and shooting, is the next major labor-saving step in coal mining. Such a machine—which would accomplish all operations now done by separate pieces of equipment — would require greater initial investment. Lower labor costs and reduced maintenance, however, would make it economical. If tons per man can be doubled, cost of bituminous coal can be reduced $1 per ton, anthracite $2 per ton. Such mining and loading machinery is in the not too far distant future for operators.

One such machine, built by Crawford-Oliphant, Inc., consists of an undercutter and gatherer, working onto a conveyor and a digger. The digging head, upper of the two elements, can be raised or lowered by jacks to work at various levels of the seam. It has a central digging tool and two swinging, digging tools, one on each side of center. All digging tools are equipped with spring and valve gears for air operation at 900–1,000 hammer blows per min., blows of 90–100 lb. Lower element has two short double bars swung from side to side by hydraulic jacks. Lower part undercuts coal while upper part is paddle conveyor for gathering coal onto a central conveyor.



Blocks of coal are cut by this Logan slab cutter, which has an undercutter bar, an overcutter bar, a shearing bar, and a severing bar.

A mining machine designed by H. C. Frick Coke Co., still in experimental stages, employs the pressure and vibration principle combined



Vibration against the face breaks down coal onto undercutter, then coal is loaded onto belt or into car by this Frick Coke Co. machine.

**TYPES 400 LANGUAGES**—It is possible to type any language which uses an alphabet on the Ralph C. Coxhead Corp. Vari-Typer. Alphabet for each language is carried on interchangeable curved plastic type font above keyboard. Guide chart shows typist which keys control which letters. Four hundred languages can be typed.
—SCIENCE ILLUSTRATED

with shallow undercutting. Breast-machine-type cutter bar, forward of the loading head, cuts a shallow kerf in coal. Coal is broken down by two hammers pressed against face. Hydraulic or air cylinders vibrate the hammers at 1,000-2,000 strokes per min. Hammer position can be regulated up and down face. Loading is done conventionally. —COAL AGE

## SEWAGE DISPOSAL PLANT SELLS SLUDGE, EFFLUENT

Using gravity flow entirely, the 5-mgd. sewage-treatment plant at Riverside, Calif., sells both sludge and effluent to nearby citrus farmers for fertilizing and irrigation of groves. Plant is fed by two 24-in. out-fall sewers, sewage first passing through a bar screen and volume-recording flume. Flocculating and sediment tanks are separated by perforated baffles only. Chemicals for precipitation and odor control are added ahead of tanks. Sewage is agitated in flocculation tanks to promote precipitation.

Straight-line sludge collectors continuously remove sludge, which is periodically transferred to digesters. Dosing siphon is provided with each of three trickling filters; rate of flow in filters is controlled by adjustment of weir heights. Filter rock is 1½-3 in.

Sludge is pumped from secondary clarifiers to digestors or to primary sedimentation effluent. Sludge digestors are 53 ft. in dia., 24 ft. deep, with hopper-shaped bottoms. Sludge-drying beds provide 2 sq. ft. per capita served by the plant. —ENGRG. NEWS-RECORD

## TELEVISION WITH BEER

So popular are television receivers in Philadelphia taverns that it is not unusual for a person who has purchased a set to receive a premium offer from a barkeep the day after it is installed. Pubs frequently increase business threefold on nights that good sports programs are telecast.

Situation is similar in New York, Chicago, other cities. —ELECTRONICS

## RUSSIA IMPROVES WELDING

High-frequency manual arc welding is being adopted widely in Russian factories. The new method is said to triple efficiency, reduce electrode consumption 50%, and save considerable power. The fine, lubricant-covered, metal electrode rests closely on the parent metal instead of being suspended. Deep penetration of arc crater permits visible part of seam to be reduced. —WELDING ENGRG.

## PERFECTS LOW-COST DIESEL

Important cost savings are foreseen by International Harvester in its recently perfected diesel tractor engine. Made up largely of standard gasoline engine parts, the diesel can be turned out on the same production line as gasoline engines.

This also will reduce diesel weight about 20%; standardized parts will simplify servicing. —AMERICAN MACHINIST

## NEW FOOD TECHNOLOGY REPORTED AT CONFERENCE

Recent developments in food technology were revealed at the annual conference of the Institute of Food Technologists. Among new applications of electronic heaters is the cooking of whole, live lobsters and the popping of pop corn on the cob, sealed in a transparent bag.

Part of the food handler's preparation for work should be sanitizing of the hands. This can be done with Chloramine T, a chlorine-releasing germicide, either in combination with soap, or after using soap.

Germicidal ices are one possible means of retarding or averting bacterial spoilage of fish. Dipping in solutions containing preservatives also is effective. Shucked clams, for example, keep 15 days when dipped in brine and sodium benzoate and packed in crushed ice.

A new development is the freezing of fresh, ocean-caught fish aboard ship. The vessels used are combination trawlers and processing plants, equipped to quick freeze and can crabs and fish. Many precooked and quick-frozen items are being developed by the fishing industry to minimize the handling necessary for cooking at home.

Among valuable fish byproducts are synthetic egg white, protein hydrolysates, agars, alginic acids, and oils used in place of olive oil for packing sardines. Chemicals useful in medicine also are obtainable from fish. Among these are various proteins, insulin, protamine, and the anti-pernicious anemia factor. Enzymes can be prepared for softening hides for leather, and livestock feed can be developed from the proteins recovered from liquor left after cooking and processing fish.

New soybean products whip more rapidly and to a greater volume than either gelatine or egg white. Soybeans are converted to foaming agents by extracting the oil from the flaked or ground bean and by partial hydrolysis and drying of the remaining grit.

Yeast has been used to remove sugar from raw eggs before drying to prevent deterioration in storage. Yeast acts only if yeast extract is added. Mucin can be retained by means of controlled fermentation. —FOOD INDUSTRIES

## GERMANS EXTRUDE COLD STEEL

Ordinary soft steel was cold-extruded and cold-drawn to high degrees of reduction, without intermediate annealing, by the Germans. Steel cartridge cases were made in large quantities by this process. A lubricant-retaining phosphate coating is applied to the exterior of the billet so that the extrusion pressure or drawing tension goes into deformation of the steel instead of into die friction. —PRODUCT ENGRG.

**JEEP TRUCK** — An adaptation of the wartime jeep, on a longer 118-in. wheelbase, the new jeep truck carries 1 ton, can go practically anywhere because of 4-wheel drive. It is powered by a 4-cyl., 60-hp. engine, is available in 7 body styles from Willys-Overland Motors.

—AMERICAN MACHINIST

## TRANSFER PRESSES SAVE SPACE, LABOR, MATERIAL

By combining as many as nine metal stamping operations in one transfer-type press, substantial savings in labor and floor space are realized. Less space is used for presses, no banking is necessary between operations, and banking between fabrication and assembly line is minimized. Compared to single simultaneous operations on individual presses, 40% saving in floor space is possible. Compared to progressive dies, operating with double-roll feed and scrap cutter—another high-production method—the transfer press saves up to 12% of stock because no strips on the sides are needed to carry the parts along. Also, the dies are less expensive to build and maintain. They are built as simple single units which can be removed and set up separately in individual presses.

Fairly deep, round stampings are ideal for the transfer press. Operations may include: blank and draw, redraw, strike, pierce, trim, extrude, emboss, wipe skirt, and pierce side holes with cam-operated punches. As ram rises after each operation, transfer mechanisms automatically move part to next operation and finally onto conveyor for transportation to washing machine. —AMERICAN MACHINIST

## CUTS LABOR TURNOVER

Two-way hiring system in which management looks at the applicant and the applicant looks at the job has cut labor turnover 60% at Victor Mfg. & Gasket Co. After a preliminary interview by the employment department, applicant is introduced to the section foreman, who shows applicant through his section and explains applicant's future work. System takes longer, but time and money spent result in reduction in length of necessary employee training, better employee-supervisor relations, improved production efficiency, and reduced labor turnover. —FACTORY

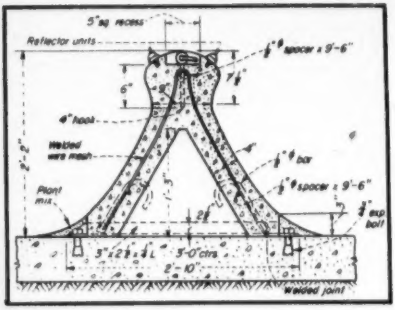
UTILITY TRACTOR—For use by contractors, farmers, and industrial plants, this 750-lb. tractor has an automatic clutch, all-steel welded frame, pivoted front axle suspension, and individual rear wheel brakes. It is made by Lincoln Tractor Co. and has a 6-hp. air-cooled gasoline engine built by Salsbury Motors, Inc. —AMERICAN MACHINIST

## MILE-WIDE GORGE SPANNED BY 66-KV. POWER LINE

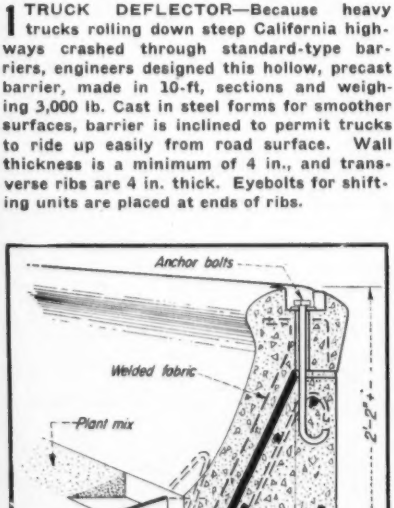
Pennsylvania Power & Light Co. has constructed a 5,367-ft. transmission line span, designed for 66 kv., across the Susquehanna River. The span is supported at each end by a novel three-mast steel structure, one conductor being attached to each mast. The masts are 14-in. wide flange H-section weighing 87 lb. per ft., varying in length from 33 to 45 ft., spaced on 30-ft. centers, and guyed. Each mast is imbedded in a concrete foundation 3 ft. square and 5½ ft. deep to spread downward thrust.

Special conductors are $\frac{7}{16}$-in., 7-strand, 30% Copperweld wire with ultimate strength of 24,650 lb. Supporting structures are 670 ft. above river on each side. Two outside conductors sag 540 ft., middle one, 510 ft. for swing clearance. Conductor attachments are double-string tension assemblies using ball and socket, 10-in. disk insulators, eight units in series.

Expulsion gaps on each supporting and adjacent structure drain off lightning charges. —ELECTRICAL WORLD




**1 TRUCK DEFLECTOR—Because heavy trucks rolling down steep California highways crashed through standard-type barriers, engineers designed this hollow, precast barrier, made in 10-ft. sections and weighing 3,000 lb. Cast in steel forms for smoother surfaces, barrier is inclined to permit trucks to ride up easily from road surface. Wall thickness is a minimum of 4 in., and transverse ribs are 4 in. thick. Eyebolts for shifting units are placed at ends of ribs.**




**2 SIMILAR DEFLECTOR has been designed for sides of roads where no shoulder exists. This barrier is now being tested. —ENGRG. NEWS-RECORD**

## ELECTRONIC COOKER SPEEDS FOOD SERVICE

Ground-beef (hamburger) sandwiches with onion are cooked in 20 sec., compared to usual 7 min., in a Radarange electronic cooker installed in a White Tower Restaurant. For take-out service, sandwiches can be cooked in the bag. Apple turnover can be thoroughly heated in 3 sec. then topped with ice cream. In a United Farmers restaurant, special dishes are served through a Radarange. In baking cakes, muffins, or biscuits, a far lighter texture is obtained because of the rapidity with which heat is introduced into the dough at a uniform rate throughout. Preparation and serving of food has been speeded enough by electronic heating to handle three times as many customers.

Railroad people are interested in electronic cooking, and a dining car has been designed with a small kitchen which leaves room to seat 68 instead of the present 48. Service would be faster, too.

Development of the magnetron and horn antenna for electronic cookers has resulted in a practical design with 13x14x15-in. oven. —ELECTRONICS

## PHOTOTYPE FOR PRINTING

Composing a strip of film negative instead of the standard slug of type, Intertype Corp.'s new Fotosetter is expected to make offset printing less involved, faster, and probably cheaper. Fotosetter operator composes on a keyboard similar to that of a linotype machine, matrix being photographed rather than filled with molten metal. A single machine can set all variations in size of one style of type merely by enlarging or reducing the face.

Film can be used for any printing plate. Changes can be made simply by recomposing one line and inserting it in negative. The manufacturer claims film is as flexible for make-up as standard type. —BUSINESS WEEK

# Food-Factory Efficiency

**Unusual methods and machines introduced by candy manufacturer make process more continuous and save labor. Cookers are mounted on turntable**

Special equipment and methods have been developed and adopted by O'Briens of California to make its candy manufacturing operations more efficient.

**Liquid Sweeteners Save**—Only sirups are used as sweeteners, saving the labor of 3 to 5 men required to handle bagged sweeteners. Storage space is reduced and mixing operations are faster with the free-flowing sirup than with a dry ingredient. Tank cars in which corn sirup is shipped have steam heating coils to facilitate unloading.

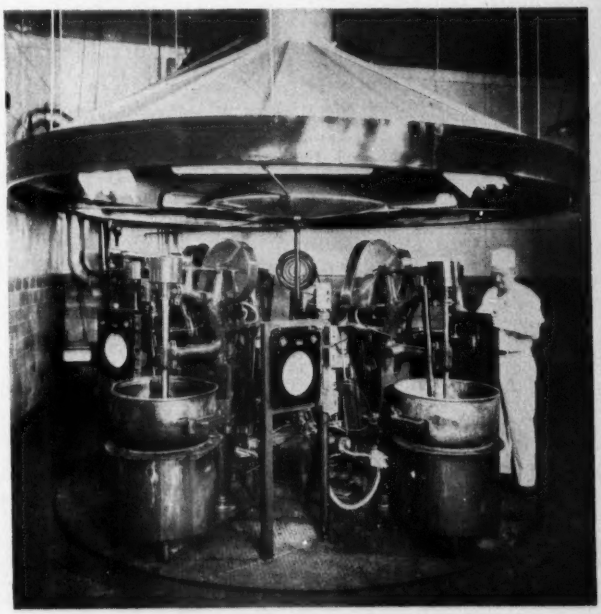
Storage tanks are lined with a baked resin plastic. It gives a smooth, hard finish at low cost. Inside the tanks, at the outlets, are 40-psi. steam coils to give localized heating of sirup before pumping. From intermediate tanks, sirups are automatically metered into blending tanks, or cooking kettles. Air at 100 psi. moves heavy sirup rapidly from the tanks.

**Efficiency with Dry Materials**—Shelled nuts, stored in 45°F. refrigerated rooms, are dumped from bags or cases into a hopper. At the base of this hopper is a timed shutter which measures the nuts into elevator buckets. A timed relay switch actuates a solenoid to operate an air cylinder that opens and closes the shutter.

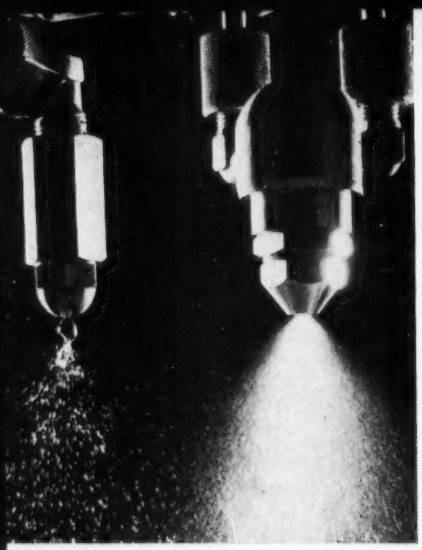
From the roaster, the nuts discharge into a portable perforated-bottom cooling tray which moves on wheels along a track to a hopper for dumping.

Both raw and roasted nuts flow from overhead bins to picking belts. Here they pass under a magnet which removes any metallic particles and then under a suction cleaner. Dust, shells, and other extraneous material picked up by suction go to a cyclone dust collector. Poor-quality nuts are removed by women stationed along the belt.

**Cooker Turntable**—Two men produce



**Two men can produce 175-batches of candy in 8-hr. in five kettles on this turntable.**



NEW GAS TURBINE NOZZLE—Oil droplets from new Westinghouse Research Lab. gas turbine nozzle are of less than 0.0004-in. dia. Six air streams meet incoming spray, and nozzle permits extraction of 96% of fuel's energy. New spray, right, is operating under same 5-lb. pressure as is the old-style nozzle, left. —BUSINESS WEEK

up to 175 batches of candy per 8-hr. day in five kettles which travel in a circle on a turntable (picture). Candy also is made in nine stationary kettles. Mounted on a central vertical shaft, the turntable is driven by a 5-hp. gearhead motor and is controlled by an automatic time relay switch. Gas for the kettles flows through a flexible-joint valve, and electricity is supplied through a commutator. Each kettle is equipped with pneumatic recording temperature controllers, used in timing the addition of various ingredients and subsequent process check-up.

The two turntable operators are so stationed that one controls the addition of preheated sirup while the other, at a second position, adds the other ingredients. The rotating table stops to permit addition of ingredients.

**Special Formers**—Toffee centers for Almond Crunch are formed into sheets by a special machine. After cooling, the sheets are broken into individual centers in a tumbler, or reel.

A special machine also produces Almond Twins—two almonds inclosed in caramel. Two caramel strips enter machine from opposing sides, and almonds feed through holes in a plate. Machine produces a sheet of ellipsoidal candies joined with caramel. These are separated by tumbling.—FOOD INDUSTRIES

## FEED PUMPS SHOULD BE CORROSION RESISTANT

New problems for boiler-feedwater pump designers have been created by the trend in feedwater treatment to supply the best water for the boiler, with little regard to pumps and valves. pH seems to be the most significant factor. Where it is above 9.0, there is only one chance in five of trouble; if below 8, three of four carbon-steel pumps will give trouble.

A more logical and positive solution is to use pump materials that stand up under practically any feedwater condition. It appears that a 5%, or higher, chromium steel does this. Nickel cast iron has fair corrosion resistance; 18-8% stainless steel seems about five times as resistant as 4-6% chrome steel, is easily cast and welded, but difficult to machine. Monel is highly satisfactory for impellers. —POWER

## LOW-COST QUALITY STEELS

Four new low-alloy steels designed to replace high-alloy grades in the aviation and automotive industries have been developed by U. S. Steel Corp. Called SuperKore, the new steels have all the physical properties necessary to meet automotive or aviation specifications. They will be cheaper than those they replace. They possess improved characteristics and are easily annealed and machined. —BUSINESS WEEK

## ADOBE BRICK, RAMMED EARTH USED TO BUILD HOUSES

Adobe brick, made water-resistant by addition of oil to mix and greatly improved over product used in early days of Southwest, is helping to overcome building material shortages in California. Contractor Pete E. Aguilar mixes dirt, sand, oil, and water at building site and casts 4x8x16-in. blocks, which are sun-dried for a week before use. Bricks are placed in 16-in. wall with ½-in. lime mortar joints. Houses are stuccoed or given three coats of linseed oil paint.

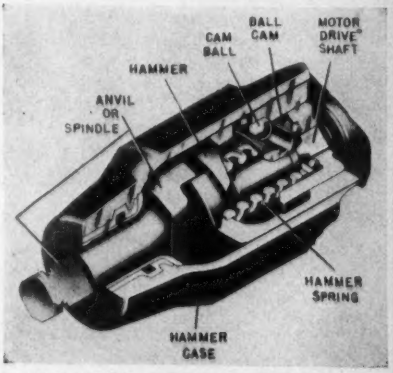
Rammed earth is used for house construction in Oregon by contractor Jack Williams. Hand-tamped in forms like those for concrete, 16-in. earthen walls are built up in shallow layers of screened sandy loam containing about 25% clay, 50% fine sand, balance coarse sand. No binder or chemicals are added to soil. Moisture content is controlled carefully, and organic material sifted out. Under ramming of 12-lb. tampers, the earth layers set rapidly, and forms are removed almost immediately. Earth walls are surfaced with 1-in. cement mortar exterior and plaster interior.

First rammed-earth house was built in 1937, and its success prompted the present venture. Cost of one-story, 1,400-sq. ft. house of this type is expected to be $3,000. —CONSTRUCTION METHODS

## FILLS BACK ORDERS FAST

A simple 4x7-in. file card listing all back orders for merchandise and hung on a peg in each bin has reduced lagtime between receipt of merchandise and filling of back orders, insured filling of back orders in proper sequence, and cut time and manpower expended in distribution and shipping at Chandler-Boyd Co. Card carries name of customer, date of order, and amount of merchandise desired. As orders are filled, order is crossed off card. Priority orders, filled out of sequence, are circled in red. —MILL SUPPLIES

**1** POWERFUL LITTLE TOOL — With standard attachments, this new all-purpose 6½-lb. electric hand tool can perform such operations as reaming, tapping, drilling, hole sawing. It can apply and remove screws, studs, bolts and remove broken capscrews. Developed by Ingersoll-Rand Co., the size 4U handles ⅜-in. (thread size) nuts, ¼ in. drills.




**2** DELIVERS ROTARY IMPACTS—Tool runs like conventional electric tool until resistance to spindle rotation reaches certain value. Then anvil stops momentarily and spring which transmits power to spindle is compressed by cam action, then released. Energy in spring is delivered as rotary power to jaws at rate of 1,900 strokes per min. Tool transmits no torque to hand.—AMERICAN MACHINIST.

# Dyes Measure Cotton Quality

**Manufacturing and dyeing characteristics and maturity of cotton can be determined by simple new dye test developed by government laboratory**

With two dyes of contrasting colors and different dyeing properties, manufacturing and dyeing qualities and the maturity of cotton can be determined, according to the U. S. Bureau of Agricultural & Industrial Chemistry. In maturity tests, dyes separate thick- and thin-walled fibers, thin-walled fibers being relatively immature and the thick-walled fibers more mature. Tests are simple to conduct.

Tests at the Southern Regional Lab. showed the progressive development of the cotton lint on the seed, relative amounts and location of thick-walled fibers on the seed, and have assisted in selection of fibers from seed for special studies. "Differential dyeing" can be used to check relative amounts of immature cotton in admixture with normally mature cotton, and also to locate cotton that would cause difficulties in manufacturing and commercial dyeing operations. Dyes have also colored neps distinctively.

Fibers of somewhat thicker walls than found in neps tend to dye to an intermediate depth between thin-walled or neppy fibers and the normal thick-walled cotton.

In fibers dyed on the seed, obtained through the 29th day, fibers dyed almost completely green, with fuzz hairs showing red. By the 32nd day, red appeared in fibers and increased steadily. Cotton from a boll that opened naturally dyed nearly all red. Fibers on older seeds that failed to develop fully were mainly on the chalozal ends furthest from the seed.

For cotton in the grey state, direct dying procedure is carried out to insure complete access of the fiber to the dye. Three-gram samples are used for tests, sample being sewed into open mesh gauze so it will lie flat. Samples are weighed, then wetted thoroughly in a quantity of boiling distilled water equal to 40 times the weight of cotton and containing 1.2% Fast Red 5BL and 2.8% Fast Green BLL dyes, calculated on weight of all cotton. Cotton is boiled 15 min. and removed from bath; a 2½% solution of sodium chloride is then stirred into the bath, and cotton samples are reentered for another 15 min. They are then removed again, and a second 2½% solution of sodium chloride is added. Samples are boiled for 45 min., drained, then washed in cold, distilled water—portions being 50:1 water to cotton. Samples are

**ONE-MAN ELECTRIC SAW**—Powered by electricity from gasoline-driven, 180-cycle generator, a 27-lb. one-man chain saw cuts timbers, trees, or limbs up to 20 in. It can be used in trees or on ground. Remote controls employ tap switches. Homelite Corp. developed saw. —ELECTRICAL WORLD

squeezed and dipped and stirred for 30 sec. in boiling water, then drained and washed again in cold water. The hot water bath removes excess red but little green, resulting in better color definition.

If elimination of the hot bath is desirable, a 0.7% red and a 3.3% green dye mixture should be used. After final wringing, samples are dried in open air or in moderate heat. Removal of the gauze and fluffing of the sample will aid drying.

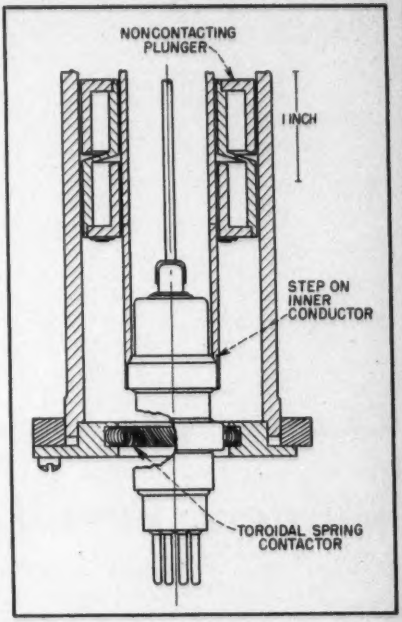
To compare different cotton samples, all samples should be dyed and washed at the same time. —TEXTILE WORLD

## NEW MACHINE REPAIRS HAWAIIAN ROADS

Badly damaged by military traffic in war years, Hawaiian Islands roads are being rehabilitated by a multiple-layer asphaltic concrete coating applied by a new combination road plane and bituminous spreader mounted on a highway patrol grader.

The road leveler has a 26-ft. steel skid on each side to support three sets of V-shaped screeds; base of V on front and rear screeds points forward, the middle one back. At front of rig is a wheeled hopper that functions as an asphalt spreader. Plant-mixed asphalt falls through hopper feeder gates to roadway ahead of front screed. As leveler moves ahead, first screed spreads material and forces excess to sides where it passes through openings to middle screed, which spreads mix and collects excess at its center where there is another control gate. Extra material moves through gate to rear screed, which distributes remainder of mix.

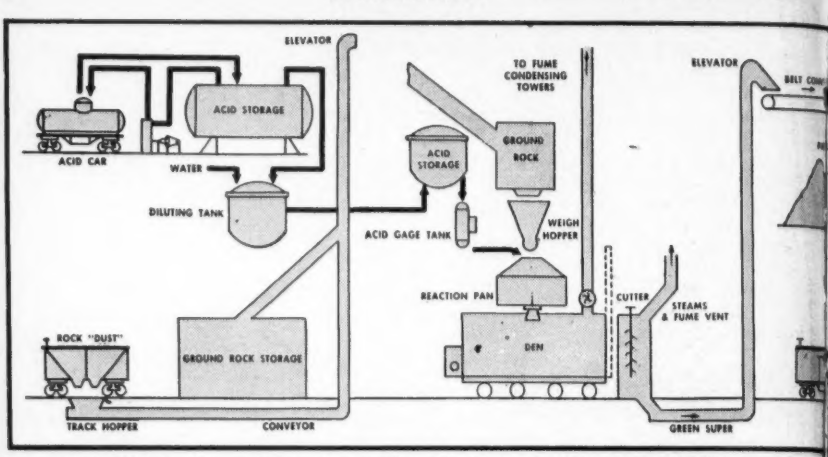
In addition to spreading mix and filling low spots in old pavement, screeds shave off high points. Usually, three passes bring roadway to true surface. Cost for ¾-in. multiple-layer resurfacing with leveler is about 50¢ per sq. yd.; with ¾-in. wearing course added, cost runs 70¢ per sq. yd. —CONSTRUCTION METHODS




**TUNABLE KLYSTRON**—Microwave electronic tubes for local oscillators whose action depends upon electron bunching operate over relatively narrow frequency range. But the 10-cm. 6BL6 reflex klystron designed by Sylvania Electric Products, Inc., for use with an external cavity, can be tuned over a full octave covering 7-14-cm. range. Tube and tunable cavity are shown.—ELECTRONICS

## BOON FOR SMOKERS

After 12 yr. of experimentation, the U. S. Dept. of Agriculture has developed a new burley tobacco with a nicotine content of only 0.003%. It can be used directly in cigarettes without blending and is suitable as filler for cigars. The new tobacco, called 31-V, has more taste and aroma than tobacco from which nicotine has been washed. Looking much like burley, it has its own taste and aroma. —BUSINESS WEEK




PROCESS is shown step-by-step in flow sheet of manufacturing and mixing.

# Modern Fertilizer Process

**Efficient, flexible plant provides close control and easily accommodates change in raw materials, grades, and formulas without long delays**

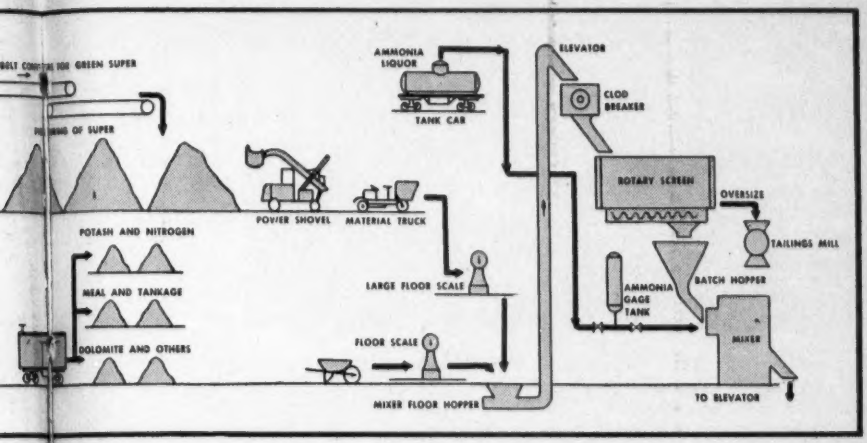
For efficient manufacture of fertilizer, flexibility in the process is essential to accommodate constant changes of raw materials and in grades and formulas. Close control of operations also is needed, to meet quality standards and insure that the operating crew is not long out of action during change-over.

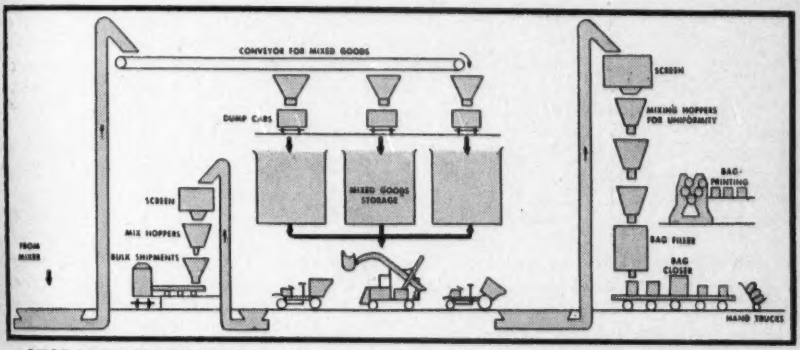
A well-engineered factory meeting these requirements has been built by International Minerals & Chemical Corp. at Hartsville, N. C. In this factory, covering a 225x420-ft. ground area, a crew of about six men make superphosphate, and crew of 12 can operate either of two mixing units for bulk shipment or stockpiling. A crew of about 20 is needed when fertilizers are being made and bagged.

**Making Superphosphate**—Conversion of phosphate rock to superphosphate takes place in about 1 min. when fine-ground phosphate rock is dropped into the reaction pan containing 54 deg. Bé sulphuric acid at about 110°F. Typical charge is a ton of rock containing 75% "bone phosphate of lime" (tricalcium phosphate), and ground 50 to 52% through 200 mesh screen. It is dropped into nearly an equal weight of acid in the cast iron pan and stirred vigorously with cast iron paddles. The soupy mix is dropped through the pan bottom into the "den." Batch reaction is repeated at about 1-min. intervals for about 25 cycles until den is full.

Reaction in pan converts tricalcium to monocalcium phosphate. Much of the fluoride in the rock reacts with the acid to form HF, which reacts with silicate to form $SiF_4$. This evolves as gas, along with water evaporated from acid by heat of reaction. Weight shrinkage is 10%.

Steam and acid fumes are pulled from top of den and reaction pan by a fan



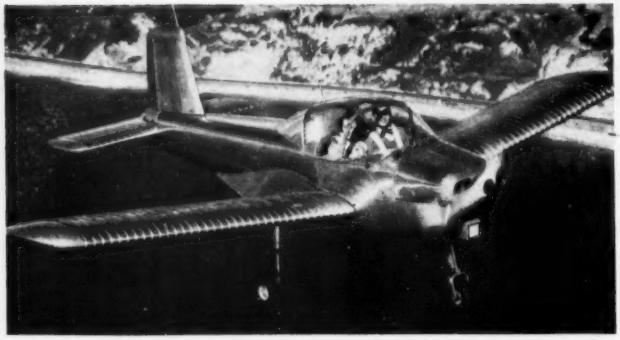

**STORAGE AND SHIPPING** operations are shown, including bulk handling and bagging.

which forces them outdoors through a four-tower condensing and cooling system. Water is sprayed in first three of the towers, forming an acid condensate which is recirculated until it reaches such strength that it may be discarded into a settling pond.

**Cutting and Curing**—After superphosphate has settled in den a few minutes, door is lifted and cutter removes the green material. This cutter is a vertical shaft with hook-like arms that revolve in the semi-solid den mass. Back wall of den moves forward, pushing superphosphate against cutter until all is removed. Elevator raises material to conveyor belts which pile it on storage floor.

Best practice requires 3-6 weeks in storage piles, but curing can be hastened greatly by rehandling and aerating, done with tractor shovels, truck tractors, and overhead dump cars.

**Complete Fertilizer**—Other fertilizer ingredients (15 to 20) are unloaded with



STALL RESISTANT—New 65-hp. two-place Thorp Skyscooter personal airplane has skin beading on wing and horizontal tail surfaces and large fillet at trailing edge of wing root. Fairing is said to eliminate any tendency of premature root stall. Top speed, 115 mph; cruising, 101. —AVIATION

power equipment into storage bins. When mixing starts, superphosphate is broken up with light blasts of dynamite, loaded by power shovel into truck tractor, and taken over large floor scale to mixer hopper. Small hand-operated trucks bring other materials over small scale. Most fertilizer formulas require 8-10 ingredients, and each must arrive in exact quantity at coordinated intervals so that each 1.5-ton batch can be hoisted as a unit from floor hopper to top mixer hopper over the clod breaker. Batches follow one another at intervals of 1½ min., requiring good teamwork by mixer crew of 12-15 men. Weigh master and mixer operator communicate by bell signals.

Clod breaker discharges into rotary screen which fills batch hopper of mixer; oversize is ground and returned. Finished fertilizer from mixer is carried by elevator, belt conveyor, and overhead dump cars to curing bins. Shipment is made by power-shovel and truck-tractor movement from bins, either to elevator, screen and hopper system for bulk loading, or to an almost identical group which feeds bag-filler system. —CHEMICAL ENGRG.

## NEW TEXTILE WASHER

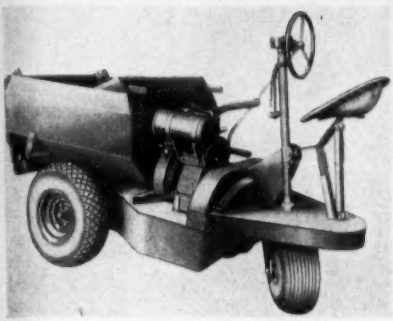
Using a patented "curve of flow" principle to cause a continuous counter-flow of water, a new tight-stand washer has been developed by Rodney Hunt Machine Co. Fabrics weighing up to 1½ yd. per lb. can be handled at a rate of 300 yd. per min. Features include: rubber-covered rail rolls using pneumatic pressure controls, a pneumatic pressure-controlled bleachery squeeze, and a stainless steel pin rail that reduces grooving of rolls through a pneumatic reciprocating device. —TEXTILE WORLD

## QUICK TURBINE START SAVES FUEL AND LABOR

High-pressure steam turbines are started in 20 min. by Consolidated Edison Co. of N. Y., reducing fuel losses and personnel and increasing available reserve factor as compared with conventional hour or more warm-up. The technique is to admit steam to the turbines at a temperature corresponding to that of the main parts of turbine assembly to avoid thermal stresses. This is done by dropping boiler pressure to 850 psi. during shut-down and adjusting excess air at superheater outlet on start-up.

Quick starting also can be used on turbines taking steam from a main header if desuperheating water is injected into steam used for starting turbine.

Vibration is reduced by the quick start, and the difficulty of bringing the unit through critical speed is thereby eliminated. —ELECTRICAL WORLD



POWER BARROW—Powered by a 6-hp. engine, the new Novo Engine Co. self-dumping wheelbarrow carrys loads up to one ton at speeds of 15 mph. Bucket has 34-in. high sides; steering is by single, airplane-type tail wheel. It has 4 forward speeds, 1 reverse; weighs 1,000 lb.—BUSINESS WEEK

## SCREWDRIVER ECONOMICS

Time and motion study preceding installation of power screwdrivers on assembly line of Bendix Radio Div. revealed that these tools pay if used 30 min. daily. Studies on both hand and power driving of self-tapping screws, screws into tapped holes, and nuts were run and results plotted. Time for positioning nut or screw was not figured, as it is the same for both methods.

Power screwdrivers were found to pay for themselves in six months if used 400 times a day. At any point on the production line where 500 nuts or screws are placed a day, power drivers were installed. —FACTORY

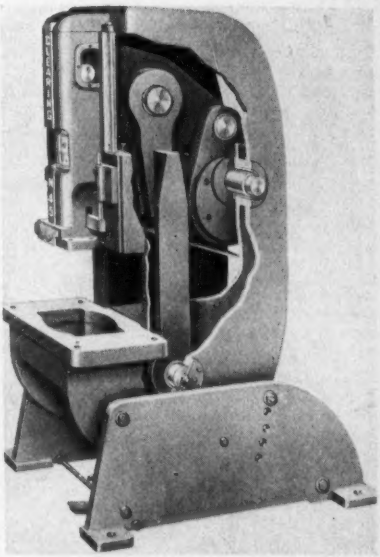
## MORE ACCURATE

Employed now for production of metal parts carrying heavy stresses, press-forming may become more widly used as a result of Clearing Machine Co.'s new 45-ton press. More accurate stampings will be made because die deflection, inherent to standard C-frame power presses, is eliminated. Deflection is produced by pressure exerted on the overhanging upper part of the frame. Load causes the frame to spread, forcing die out of alignment.

In new press, point of loading has been moved to lower part of frame, upper part serving only as guide for slide. This will give truer stampings, extend die life 2 to 5 times, cut die regrinding. —BUSINESS WEEK

## 8 NEW SUPERSONIC PLANES

Eight fighter planes for trans- and super-sonic speed are being pushed by the American Army Air Forces without waiting for completion of fight tests of existing supersonic aircraft. All of these new planes are scheduled to fly before the end of the year. Fighters have swept-back wings, turbojet engines, and rocket boosters. —AVIATION WEEK



New press lowers load point from upper frame to give more accurate stampings.

# TECHNICAL SHORTS

**Better Products Quicker**—In designing new equipment, Continental Motors makes sectional castings and tests them before making complete pattern. This eliminates expensive changes and delays that would be involved if finished pieces were inadequate and master patterns had to be revised. Weight of parts is checked by water-displacement, saving hours of calculations which may be off 10%. —AMERICAN MACHINIST

**Cuts Bratticing Costs**—Hanging brattice cloth on spads, using nails for fasteners, is now practiced by many U. S. mines. Cloth is supported on case-hardened spads, of 10- to 20-gage rolled steel, 2½-in. long and ½-in. wide at butt end. Line brattice are erected by driving spads into roof at right angle to direction cloth will be hung. Cloth is stretched over spads and hung by 8-d. nails, which are threaded through cloth 1 in. from edge. —COAL AGE

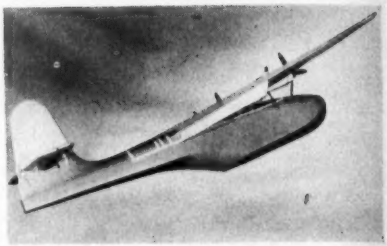
**Flexible Store Power**—Plug a circuit breaker into a vertical feeder, and additional power is available for special merchandise displays on any of 12 floors of Dayton Co.'s big department store. This flexibility is attained by industrial lateral busduct feeder installed vertically. —ELECTRICAL CONST. & MAINT.

**Air Conditioning Aids Mill**—By air conditioning three of its nylon hosiery mills, Gotham Hosiery Co. will be able to use finer yarns at higher speeds. Before air conditioning, tolerances were so close that abnormal temperatures or humidities caused gumming and kinking of yarn. —BUSINESS WEEK

**Saving by Safety**—Six-year average cost of mine worker compensation at St. Joseph Lead Co., a self-insurer, was only $1.13 per $100 of payroll, because of an effective safety program. Average cost for mine in same state was $5.30. Company finds that $1 spent for accident prevention can return up to $4. —ENGRG. & MINING JOURNAL

**Headless Bolts**—Three of every 10 new automobiles now are minus the bolt heads which formerly marred the streamlined surface of bumpers. Bolts are attached to inside surface by stud welding. —WELDING ENGRG.

**Bulldozers Team Up**—Two bulldozers operating side by side move more than twice as much dirt as one in work on small dams in north Texas. —CONSTRUCTION METHDOS



**PLANING TAIL HULL**—Drag of hull in water has been reduced as much as 50% by this planing tail hull designed by the National Advisory Committee for Aviation. It has V-shaped planing surface at tail and step and well-faired step.—AVIATION WEEK

**Effective Emulsion Stabilizer**—For stabilizing citrus-oil emulsions, mixtures of gum arabic and gum karaya are better than gum arabic-tragacanth mixtures. Mold growth can be prevented by increasing the glycerine content of emulsion, substituting more propylene glycol for glycerine, or using 0.1% sodium benzoate. Used alone, tragacanth is best of three gums. —FOOD INDUSTRIES

**Ends Conditioner Corrosion**—In air conditioning systems, corrosion can be prevented by: (1) Use of an alkali to counteract absorption by water of acid gases from air. (2) Simultaneous use of a chemical passivist, like sodium chromate, to protect metal surfaces. These chemicals preferably are fed into water at rate proportional to absorption of impurities. —POWER

**Low-distortion Radio Tube**—Low harmonic distortion is obtained from an audio output tetrode power tube in which the first grid is made positive to act as a space-charge grid, and second grid is used as control electrode. An experimental tube gave 2.4 watts of audio output into a 7,500-ohm load with only 1.5% total distortion. Distortion is lower, but power sensitivity less, than for beam-power tube. —ELECTRONICS

**DDT Whitewash**—Effective life of DDT in 10 months when mixed into whitewash. Mixture is 1 gal. of skimmed milk, 4½ lb. of spraying lime, 1 qt. of 25% DDT. Milk gives enamel-like finish. —SCIENCE ILLUSTRATED

**Barney Spots Mine Cars**—Coupling and uncoupling of rope during spotting of mine car trips is unnecessary at Rail & River Coal Co. since the installation of a barney fitted with a gravity dog. A section of prefabricated track, slightly longer than two cars, and a traction type reversing hoist are mounted along a section of track. In the center between two track rails are two more rails set on edge a foot apart to guide barney. Gravity dog engages bottom of car to move it forward. Operator controls barney by pushbutton. —COAL AGE

**Air Conditioning Cuts Ends Down**—By air conditioning its spinning room, Pacolet Mfg. Co. has reduced its ends down to 20-30 per thousand ends per hr. Temperature and humidity are controlled at 80°F. and 50% rh. Employee comfort, however, was primary objective. —TEXTILE WORLD

**Reduces Ham Spoilage**—Spoilage of hams during curing has been reduced to point where it no longer is a commercial problem. If meat is quick-chilled to 35°F. immediately after slaughter, and initial curing temperature held below 38°F., growth of spoilage bacteria is inhibited until curing mixture can hold spoilage organisms in check. Artery pumping also curtails spoilage by decreasing curing time. —FOOD INDUSTRIES

**Permeability Tuning**—Permeability tuning has been used widely in automobile radio receivers and found very satisfactory. Advantages over gang capacitor are smaller size, lower cost, improved signal-to-noise ratio when tuning a small-capacitance antenna. In home receivers, degradation of loop performance is encountered, particularly in table models. —ELECTRONICS

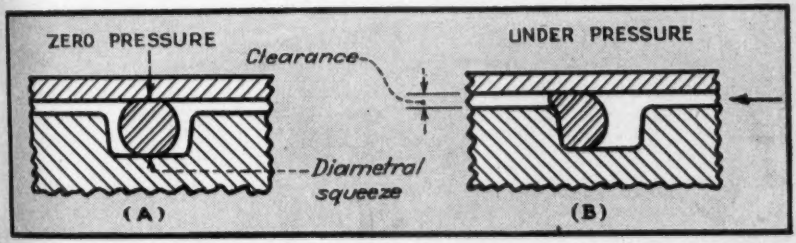
**Removes Mill Scale from Boilers**—No longer considered a surface protection for boiler parts, mill scale (chiefly ferroso-ferric oxide) is being removed by chemical solvents (usually muriatic acid) before operating the boiler. Scale removal avoids concentrated corrosion at scale cracks, electrolytic corrosion with alkaline water, and scale insulating effect. —POWER

**Color Metallurgy**—Determination of iron in light metal has been done by color in Germany. Metal is dissolved in acid solution, which is then combined with sulphosalicylic acid. Presence of iron turns solution red, and amount of iron can be measured with electric colorimeter. —PRODUCT ENGRG.

**Skin Balm Lubricates Dies**—Unguentine, sold in tubes to soothe burns, now is bought in barrels to lubricate dies which draw lithographed sheets into containers and automobile instrument panels and garnish moldings. It is said to prevent paint skin from cracking in drawing. —AMERICAN MACHINIST

**Rolling Straightedge**—Surface variations in new pavement are checked by pushing aluminum I-beam mounted on three wheels along road. End wheels are 10 ft. apart and rigidly attached to frame, while center roller is free to move up and down. Amount of deviation is shown on exaggerated scale; electric buzzer warns operator when tolerance is exceeded. —CONSTRUCTION METHODS

**Cleans Settling Tanks**—A perforated-bucket elevator is used to remove ½-mm. slurry from settling tanks at Windsor Coal Co. Elevator travels slow enough that slurry loses most of its water before it is dumped into refuse cone. —COAL AGE




**TIGHT SEAL—O-ring packing for hydraulic cylinders and pistons, developed during the war, has many advantages: simple construction of seal; dependable through wide range of pressure, temperature, speed; long life; easy assembly and replacement; low cost. The O-ring is molded of synthetic rubber to close tolerances. It is fitted into rectangular groove machined in hydraulic mechanism. At low pressures, resilience of the compressed ring furnishes sealing force. Under high fluid pressures, distortion of cross sction of synthetic ring augments sealing force. —PRODUCT ENGRG.**

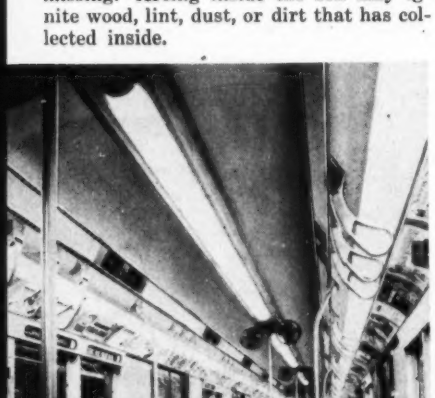
# Causes of Electrical Fires

**45% of all industrial electrical fires during the period 1939-45 were caused by improper maintenance. Principal causes are revealed in special report**

According to Associated Fires Insurance Cos., 45% of all industrial electrical fires occurring between 1939 and 1945 were caused by careless or improper maintenance. The following examples are the most frequent causes of fires.

Contacts on motor controllers that become worn and dirty arc severely, creating a fire hazard. They should be replaced if worn, burned, or pitted. Grounds for lightning-arrestor conductors often are installed in iron pipe for added mechanical protection. Nonferrous pipes should be used for protection, as iron pipes tend to obstruct discharge of current to ground.

Inspectors find fuse box doors frequently open, missing, or fitting poorly. Some are of wood, lined with asbestos, in which lining is partially cracked or missing. Arcing inside the box may ignite wood, lint, dust, or dirt that has collected inside.



Bridging of defective fuses is the most frequent single cause of fires. Methods of bridging defective fuses are almost as numerous as the fires they cause. Corroded, bent, or broken fuse clips, lacking tension and fitting loosely, do not give good contact with fuse ferrule or knife blades. Heating starts at contacts. Arcing will finally melt clips and knife blade.

Starting handles on motor controllers often are plugged, tied, or blocked in running position because latching mechanism is out of order. If power on motor circuit is interrupted on running side of controller, the handle cannot return to neutral. Result—burned out motor, damaged controller, or damaged machinery.

Careless installation, excessive vibration, or abusive use may pull flexible armored cable from its connector, leaving insulated conductors exposed. Short circuits will result after abrasion.

When brushes or commutators on commutator-type motors become dirty or badly worn they often are a source of danger.

Other defects easily recognized and remedied are:

1. Loose open wiring resting on pipes and beams.
2. Long, frayed cords on drop light wound around nails, pipes, or beams.
3. Worn cords on movable equipment.
4. Missing, damaged, or poorly fitting covers on switchboxes, panel boxes, and motor controllers.

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**FLUORESCENT SUBWAY**—First of 650 new subway cars to be equipped with fluorescent lighting has gone into service in New York City. Three continuous rows of instant-starting cold cathode lamps will furnish twice as much light as in the present subway cars. —ELECTRICAL WORLD

5. Missing fiber bushings in caps on metal sockets for drop lights.
6. Broken housings on lamp sockets.
7. Oversize fuses.
8. Missing covers on thermal cutouts.
9. Makeshift paper lamp shades.
10. Oil soaked and badly worn motor leads.
11. Oil-soaked and dirty motor windings.
12. Oil-soaked control apparatus around machine tool equipment.

Common defects not readily detected include:

1. Low and dirty oil in circuit breakers and starting compensators.
2. Uneven air gaps in rotating motors.
3. Leather bellows too stiff in certain types of solenoid overload relays.
4. Oil in dashpot too thick and gummy in the overload relays.
5. Thermal relays in motor controllers too large for proper protection of motor.
6. Loose parts on operating mechanism on switches and circuit breakers.

Through careful thought and planning, electrical equipment ceases to be a source of danger. —FACTORY

## CONTINUOUS BLEACHING OF COLORED-YARN GOODS

Only one J-box is used in the continuous peroxide-bleaching, single-stage range for all finished goods production at Highland Park Mfg. Co. It was designed to bleach continuously colored-yarn dress goods and shirting averaging 4 yd. per lb.

Goods are first sewn in grey room. Steps in preparation for bleaching are: desize, wash, partially dry, mercerize, and wash. In bleaching, cloth passes through wash box, squeeze, and hydrogen-peroxide saturator, which is fed from a stainless steel mixing tank. Goods enter J-box from saturator for steaming —usually about 1 hr. Cloth is then washed in a 10-compartment slack washer, either hot or cold wash being used. Bleached cloth is then piled in boxes for further drying and finishing operations.

Through bleaching, cloth is rope form. Speeds average 125 fpm. Steam is applied in J-box through chests on both sides of one section of box, steam being discontinued in curved bottom section. Box is 5 ft. wide. —TEXTILE WORLD

LIFT-OUT CONSOLE—Small console radio-phonograph with a lift-out table-model radio has dual use in home. Housed in a plastic cabinet, it operates on five tubes and rectifier. Unit, developed by Westinghouse Electric Corp., has an automatic record changer. —BUSINESS WEEK

## NEW IN RUSSIAN MINING

Russian engineers recently announced a new luminescent, explosion-proof, miner's lamp emitting light resembling daylight. Lamp is over 12-in. long and of 0.8-1.6-in. dia. Tungsten electrodes at each end are covered with barium and stentium; tube is filled with mercury and argon vapor under light pressure. . . . Ferro-concrete tubular pit props are used in Donets coal mines. Plans are to employ props in ore-mining also. . . . For drifting vertical pits, an 8-ft. dia. drill, driven by a water turbine, is now in experimental stages. —COAL AGE

SNOWMOBILE—Operating with equal ease over ice or snow Sno-Cat also travels over bare ground when wheels are lowered to take weight off of skis. Propelled by "floating drive" link tracks, machine navigates 35% cross-hill slopes. The 115-hp. Dodge motor, with 4-speed transmission, gives 3-10 mph. in deep snow, 10-15 mph. on broken trails. Tucker Sno-Cat Co. developed the vehicle. —CONSTRUCTION METHODS

## UNDERCASTS AID SAFETY IN COAL MINE

In operation of a gaseous coal mine, Barnes & Tucker Co. uses undercasts rather than overcasts when air must cross a belt. Undercasts have proved cheaper and more successful than overcasts. Mine operates seven belt sections, daily production running 3,000 tons.

A drift mining operation, seam is 40 in. deep. An 8-in. layer of bone overlies the coal, topped by a 10-12-ft. layer of fairly firm slate. Bone is left in place in rooms, but is removed in beltways, manways, and track haulageways. A five-entry system is driven for mains in advance of belt entries, and an additional entry is driven off the butt entry of belt setup, forming an additional return on each side of the main. Main headings and adjoining manways are intakes, right and left airways being returns.

Each section is supplied with air at the rate of 10,000 cfm. Undercasts, carrying return air across belt headings, cost $100 against $350 for overcasts. Air passageway in the 12-ft. long undercast is 6 ft. wide, 5 ft. deep. Undercast is excavated after belt is in place, excavated material being hand-loaded onto belting.

With current ventilating fans, 225,000 cfm. is supplied, methane content averaging 0.3%. Horns blow if fan stops running. Coupled with dust control on cutter bars, loaded cars, and roadways, system greatly reduces danger of ignition. —COAL AGE

## CONTROL SHRINKAGE IN WOOL, COTTON, RAYON

Two new processes to control shrinkage in rayons, cottons, and wools recently have been announced. Developed by Alrose Chemical Co., "Definized-G" process will hold residual shrinkage in cottons and rayons to 1%. The glyoxal combined with a catalyst is effective regardless of weight or width of material. Tensile strength and abrasion resistance are not affected. Applied with standard finishing equipment, material is cured at 270-350°F. for 3-6 min.

"Pacifixed," developed for wools, will leave material as easy and safe to wash as any other fabric. Wool treated with the Pacific Mills Worsted Div. process showed less than 2% shrinkage under test. —BUSINESS WEEK

## MAKE FLYING SAFER

After flying in a *Constellation* equipped with the new Hughes Aircraft Co. 16-lb. $135, radar terrain-clearance indicator (McG-H Digest, July, p. 32) the Presidential air safety inquiry board approved the instrument, one of four terrain detectors now approved. The board advocates the use of one of the four on air transports as a secondary aid to pilots. The other electronic terrain indicating units approved are the 150-lb. airborne scope radar set developed jointly by the Navy and American Airlines, the Allison 65-lb. scope radar, and the wartime radio altimeters, which are now selling as war surplus equipment at only $75 per unit. —AVIATION WEEK

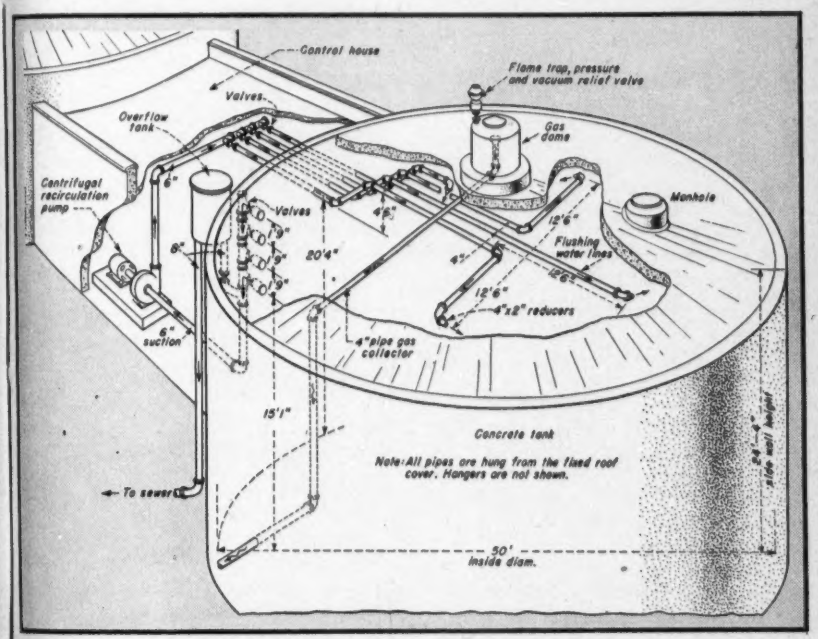
## PARTNERSHIP PLAN PAYS

Employee productivity is up 271% at Auto-Saler Co., due primarily to a partnership program for employees. After 12 months of continuous employment, employees become partners, 105 of the 140 now being partners. They become the employee governing body, operating through a 5-man board of partners. Board members are paid $100 per year for after-hours work.

Board makes recommendations to partners and to management. Management frequently turns ideas over to the board for study. Major plans developed by the board include profit-sharing, stock ownership by partners, vacations, and employees' manuals. —FACTORY

## NEW GERMAN FERTILIZER

A new method of making fertilizers without using phosphoric acid has been developed in Germany. Raw phosphate rock is treated with nitric acid, and excess calcium is precipitated as calcium nitrate tetrahydrate, also a fertilizer. After the phosphate material has been neutralized with ammonia gas, it is granulated, either with slag or potassium salts, and dried. —FOOD INDUSTRIES




CONTROLS SCUM—Collection of deep scum layers is prevented in sewage sludge digestion tank by piping and pumping installations which permit wetting, heating, and agitation of sewage. Nozzles, at 45 deg. angles, above surface, induce circulation in scum zone. Warm liquor from "clear zone" can be pumped onto floating layer, liquor passing through a heat exchanger before returning to tank. Recirculation system is operated about 1 hr. per day, from control house. —ENGRG. NEWS-RECORD

## MINE CONVERTS CUTTERS

Conversion of shortwall cutters into top cutters and shifting to bottom shooting has reduced contamination of coal and falls on tracks in a Pennsylvania coal mine. Necessary modification on the Jeffrey 35B was accomplished in the mine shops. Vertical shaft was lengthened 8½ in. Sprocket teeth were removed, with sprocket serving as a clutch; sleeve bearing on shaft was replaced by roller bearing. Machine is supported on ¾-in. steel plate 34x76 in.; top housing is ¾-in. steel plate 32x56 in., which supports cutter bar and top bearing. Two hydraulic jacks at front and one at rear are controlled from central control panel on left rear of machine. —COAL AGE

## DOING THE UNUSUAL

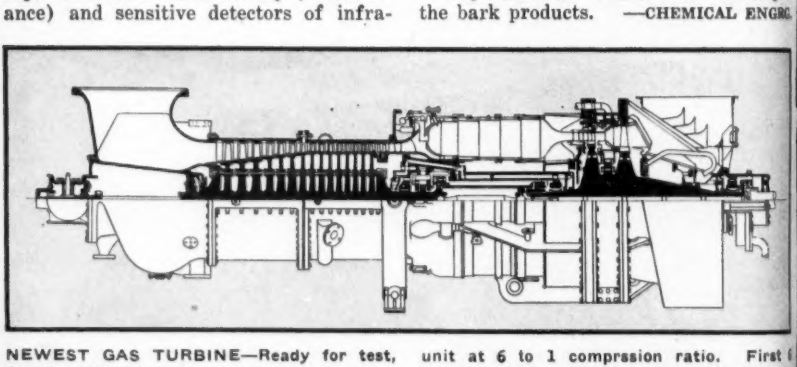
Diamond dies for drawing fine wires are drilled by electrical sparks formed between a needle point and the diamond. Time is 40 hr., against 150 hr. by conventional drilling. . . . Metal-ammonia solutions rapidly frozen to –85°C. are super-conductors of electricity (no resistance) and sensitive detectors of infrared rays. Some 40 other materials are superconductors at close to –273°C.

X-ray diffraction identification of crystals at 1500° C. can be done by replacing the photographic film by a Geiger counter. The counter is moved through the diffraction pattern by a synchronous motor, and the pattern recorded on a strip chart. —ELECTRONICS

## 5 PRODUCTS FROM BARK

Five products now are made by grinding and screening bark previously wasted in Douglas fir timber operations and representing 12% of a saw log. The products consist essentially of cork flakes, short fibers, tissue powder, a cork-fiber combination, and a cork-fiber-powder combination. They have wide present and potential applications, including soil conditioning, smoke curing of meats, reactive ingredient in phenolic resin manufacture, insecticide conditioner, ingredients in match igniting compounds and magnesite flooring, as absorbent filler for explosives, and foundry parting material.

Weyerhaeuser Timber Co. developed the bark products. —CHEMICAL ENGRG.



**NEWEST GAS TURBINE**—Ready for test, General Electric's first post-war general-purpose gas turbine burns Bunker C oil. At 6,700 rpm. with 1400°F. gas temperature, it develops 4,800 shaft hp. at 1,500-ft. altitude and 80°F. ambient air. Overall thermal efficiency is 17%. Some 15 axial-flow compressor stages pump 70,000 cfm. through unit at 6 to 1 compression ratio. First 6 stages are aluminum alloy; others, 13% chrome steel. Air is extracted for turbine wheel cooling. The 6 combustion chambers resemble those of aircraft units. High axial velocities result in a low-stress bucket suitable for high combustion-gas inlet temperatures. —ELECTRICAL WORLD

CARRIES MAIL, DUSTS CROPS—Bell Aircraft's modified Model 47 serves either as a mail carrier or a crop duster. Two mail compartments carry 500 lb. of mail. If DDT-hoppers are installed, the craft becomes an efficient crop duster. —AVIATION WEEK

# What's New in Aircraft

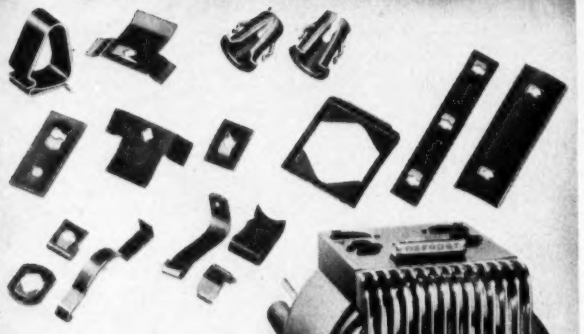
**Beech designs feederline plane with removable seats and cargo bulkhead. B-36 to carry up to three fighters. World's largest helicopter passes flight test**

Designed for feederline service, Beech Aircraft Corp.'s Model 34 is fitted with easily removable seats and cargo bulkhead to accommodate variations in passengers and cargo. Plane is powered by four 320-hp. Lycoming engines driving two propellers. Engines are arranged spanwise in wing, driving propellers through gears. No performance details have been released. . . . The smallest fighter ever developed, the XP-85 is to be carried in the bomb bay of the new B-36. The parasite fighter will be dropped with wings folded; recovery will be by dirigible technique. Mother plane will carry up to three fighters. The stubby, barrel-shaped fighter fuselage houses a Westinghouse 24C turbojet unit which will give the plane a 650-mph. speed at sea level. Plane has no landing gear. . . . Ready for flight tests is the French helicopter using its 170-hp. Mathis engine as a compressor to turn rotor blades through tip jets and to drive standard 3-blade, fixed-pitch propeller at rear for forward motion. Horizontal stabilizer supports fixed vertical fin, and conventional rudder is carried by prop shroud ring. —AVIATION WEEK

World's biggest helicopter, the XR-10, weighing 11,000 lb., has passed flight tests. Twin 525-hp. engines drive two 3-blade rotors. Craft carries 10 passengers. Range is about 350-miles, max. speed 100 mph. —BUSINESS WEEK

Rotowing Corp. soon will have the prototype of its new 2-place helicopter flying. The twin-rotor ship will have a 400-mile range, cruising speed of 90 mph., and useful load of 411 lb. Sale price will be under $5,000. . . . Lockheed may convert its P2V *Truculent Turtle* into a long-range, 20,000-lb. payload freighter. Two Wright type 3350 engines would power the transport. . . . Designed for feederline service by Percival Aircraft Co., the *Merganser*, all-metal, single high-wing, twin-engine transport carries eight passengers and crew 300 miles. Fuselage lies low on tricycle gear, has large push-out emergency panels on both sides. Outrigger wheels retract forward and up behind engine firewalls. Nose wheel is not steerable.

Convair's twin-jet, flying boat fighter, the *Skate*, will feature sweptback, tapered wings, butterfly tail, and long, slim hull. —AVIATION NEWS



SAVE ASSEMBLY TIME — Forty-four sheet metal fasteners of 14 different types are used to assemble a gasoline automobile heater by Galvin Mfg. Corp. Standard fasteners were adopted as widely as possible. Rapid assembly results because many parts are snapped into position under the spring tension of clips, others by pressing fasteners over integral studs. Compactness and ease of disassembly are retained. Spring-tension loading prevents vibration loosening. The Speed Nut fasteners need no lock or spanner washers. — PRODUCT ENGRG.

## STEEL BEER BARRELS QUICKLY MADE

Steel beer barrels not only outlast the wooden ones, but they can be fabricated readily on an assembly-line basis. Steel Cooperage Co. turns out 1,500 a day with three seam welders and two spot welders, electronically controlled.

A barrel is made of two halves, deep drawn from 16-gage mild-steel sheet. A deep-drawn jacket half that provides a runner and chime is resistance welded to each barrel half by a 250-kva. seam welder. Then two jacketed barrel halves are pressed together with an accurately controlled overlap. After clamping to maintain alignment, the assembled halves are tacked by a spot welder, then mash-welded. In the latter operation, pressure of the electrode wheels causes the slightly overlapping pieces to mash together, effecting the weld edge to edge. Because the copper-alloy electrode wheels tend to score, their surfaces are dressed by knurls while they operate. Lower arm of welder enters barrel through hole at one end, this hole being closed by an arc-welded plate. Arc welding also attaches bung fitting.

After assembly, barrels are washed, treated with acid, lined with special paint, enameled outside. Infrared dries coatings. —WELDING ENGRG

## BUSES STOP FOR INFIRM

As an added service, Wisconsin Public Service Corp. issues a special courtesy card to infirm passengers which permits them to dismount buses at nonscheduled stops. Passenger must show card to operator prior to arrival at desired stop. About 75 such cards have been issued. Company does not feel privilege is being abused. —BUS TRANSPORTATION

## 3-WIRE SYSTEM IN MINE REDUCES POWER LOSSES

Voltage loss has been reduced 70% and energy loss to about one-third that of standard 2-line, 275-volt systems, with the same amount of copper, by the installation of a 3-line dc. distribution system at Gay Mining Co. The line is along a 4,800-ft. haulageway, between substation and point where circuit branches.

With balanced loads, there is no current in track or grounded neutral. Dc. power is supplied by one stationary substation consisting of two 250-kw. synchronous converters in series, developing 600 volts. The track or neutral conductor is connected to the tie line or bus between the two converters.

If a converter breaks down, or only one is needed, either converter can be disconnected from the circuit and a feeder switch closed, energizing both mine feeders. Trolley along crop line is sectionalized, the above and below ground sections being separated. Sectionalizing point consists of two trolley-wire section insulators with a 3-ft. dead block between them.

For advantageous use of the 3-wire, dc. system in mines, the following are prerequisites: two generating units in same substation; location of substations close to load center is impracticable; two widely separated centers fed from junction point several thousand feet away from the substation; and also a high load factor. —COAL AGE

## SUPERSONIC SICKNESS

High-frequency sound waves generated within a narrow cone around the tailpipe of jet engines causes "supersonic sickness." Not dangerous, the malady takes the form of general lassitude, unsteadiness in walking, and nausea. It affects test engineers, but pilots are seemingly unaffected due to shielding and distance from cone. —AVIATION WEEK

## ALUMINUM RAILWAY CAR

Constructed principally of aluminum alloys, a railway coach-baggage car built by American Car & Foundry Co. is 34% lighter than a steel car. Even body framing is aluminum, except for bolsters, cross bearers, and sills. Extruded aluminum alloy sections are used for many framing members. —PRODUCT ENGRG.

TEN MACHINES IN ONE—One or two operators with this 10-station machine can drill 89 holes in Buick cylinder head blocks at one time. This trend toward automatic transfer of work is gaining. In-line transfer is most common, but some machines work in squares or circles, work returning to starter for unloading. — BUSINESS WEEK

# NEW PRODUCTS

**Makes Brick Fast**—Six bricks every 3.5 sec., at a cost of less than $10 per thousand, are made in the continuous-conveyor machine developed by Brickmasters, Inc. Foundry slag, sand, cinders, ore, volcanic ash, or other waste material may be used. Unit weighs 3,600 lb. and is assembled in 2 hr. Standard size brick, in singles, multiples, or slabs, can be produced. —ENGRG. NEWS-RECORD

**Odorless Deodorant**—For general deodorizing in factory and toilet rooms, the new Odex of Ranetite Mfg. Co. has no odor. It includes potassium permanganate; it is said to act as a germicide. —FOOD INDUSTRIES

**Foolproof Altimeter Setting**—Basically a precise aneroid barometer, the new Kollsman Instrument Div. altimeter-setting indicator requires no computations or adjustments. It is actuated by evacuated, springless aneroid diaphragm, movement being translated by gears to pointer. Hysteresis and friction are reduced by frictionless spring suspension. —AVIATION WEEK

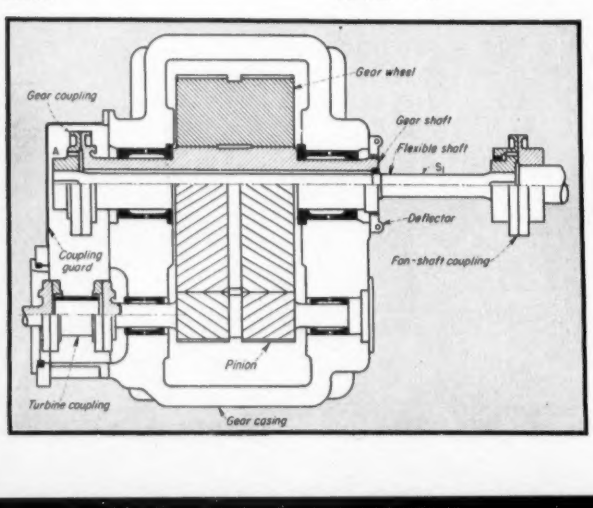
**Fume-resistant Enamel**—Interior walls and ceilings subject to acid, alkali, or sulphide fumes can be painted with Fumex, a new white enamel of A. C. Horn Co. It may be applied to brick, concrete, plaster, wood, or metal. —POWER

**Fast Plastic Molder**—Thermosetting plastics are preformed, preheated, and molded in one fast operation in the Hy-Jector announced by Rockford Machine Tool Co. All movements are hydraulically powered, electrically controlled, and automatically timed throughout the cycle. Cycle can be set on control panel and requires no further attention. Production is said to be speeded as much as 400%. —AMERICAN MACHINIST

**Clip-on Color Lighting**—Aluminum clips with interchangeable color filters, designed to fit any R40 reflector-type lamp, can be used for color effects on merchandise displays. Sixteen color filters are available. The Sylvania Electric Products, Inc., development weighs 5 oz. —ELECTRICAL WEST

**Worm-geared Clamp**—Developed for military aircraft, Aero-Seal stainless steel hose clamp with worm-gear tightener now is available for industrial use. —CHEMICAL ENGRG.

**Self-melting Solder**—With a strip of solder on one side and a strip of plastic on the other, a new tape for spliced wire joints is self-soldering. After wrapping splice, end of tape is ignited with a match, and the plastic burns to melt solder and flow it over fluxed wires. W. B. Franklin Co. introduced it. —WELDING ENGRG.




**VIBRATION PROOF — High-speed gears engineered by General Electric Co. for boiler fans driven by steam turbines have long, light, flexible fan-drive shaft, with flexible coupling. Special coupling also connects turbine and pinion gear. Gear wheel and pinion are precisely machined, aligned, balanced. Gear wheels are pressed and keyed on low-speed shafts.** —POWER

**Printed Radio Coupler**—Measuring only 1 x ¾ x ⅛ in., the Couplate includes a coupling capacitor, 0.01 microfarad; plate r-f bypass, 250 mf.; plate load resistor, 250,000 ohms; grid resistor, 500,000 ohms. A new commercial application of printed circuits, it is designed by Globe Union, Inc., to suffice for interstage coupling in over 90% of present radio receivers. —ELECTRONICS

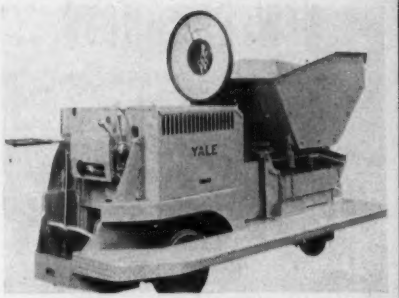
**Drum-control Lathe**—Time-saving automatic drum-control is incorporated in a new line of 16-in. Electro-Cycle turret lathes of Warner & Swasey Co. Mounted on ram and mechanically actuated by forward or backward indexing of hexagon turret, it automatically controls working sequence. Developed primarily for brass, the unit can be used to turn bronze, aluminum, or other nonferrous metals and plastics. Four drums each serve one spindle function: start and stop, reverse for threading, high and low speed, right- and left-hand rotation. Six adjustable knobs for each drum permit rapid setup for any desired working sequence. One company increased production 30% with unit. —AMERICAN MACHINIST

**Positions Screen Printing**—Designed to lay cloth accurately on screen-printing tables, a new Spinelli Machine Co. unit prevents wrinkles, speeds laying, and permits better register. The machine features ball-bearing construction, adjustable tension bar, two solid wood positioning rollers, self-adjusting roller guide rail bearing device, and a locking mechanism. —TEXTILE WORLD

**Turbojet Starting System**—"Hot starts" are avoided in a new turbojet engine starting system. Fuel is introduced in only two chambers equipped with starting plugs, heat of combustion traveling to other chambers. Fuel is then introduced to these chambers, providing smooth starting at about 1,350° F., danger of thermal shock thus being eliminated. Bendix Aviation Corp. developed the starter. —AVIATION WEEK

**Handy Snake Bite Kit**—Quick emergency snake bite treatment is provided by a new vest pocket snake bite kit, weighing less than a package of cigarettes. Kit contains hand-operated suction pump, tourniquet, hermetically-sealed iodine brush, knife, compress, ammonia inhalents, and tapered-suction pump adapter for fingers or toes. Snake bite kit is a development of Mine Safety Appliance Co. —SCIENCE ILLUSTRATED

**Sands Curved Surfaces**—Curved surfaces of wood, metal, or plastic are sanded by abrasive sheets stretched over a sponge rubber pad on the new sander of Sterling Tool Products Co. Abrasive sheet size is 3⅝ x 10¼ in. —ENGRG. NEWS-RECORD




**PORTABLE BATCHER — Materials are weighed out in batches, transported about factory, and dumped by new Yale & Towne Mfg. Co. unit. The 40-cu. ft. dump hopper is supported by coil springs for shock protection. It is similar to general-purpose electric load carrier. —FOOD INDUSTRIES**

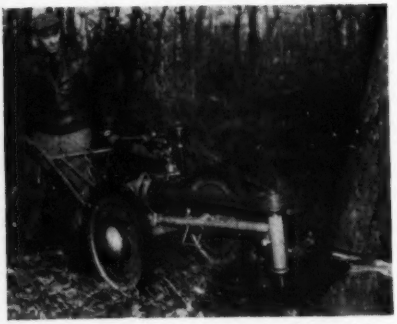
**Slide-valve Steam Trap**—Condensate is discharged in continuous stream, varying in rate with rate of accumulation, by a new slide-valve trap developed by W. S. Rockwell Co. As float rises or lowers, it moves slide valve over orifice. Continuous flow permits use of a smaller trap for given discharge. —CHEMICAL ENGRG.

**Mass-production Cooker**—Applesauce is produced at rate of 6,000 lb. per hr. by a continuous cooker introduced by Allen Iron & Welding Works. A paddle mechanism agitates the chopped-apple-sugar mixture as it is cooked by steam in a long chamber. Apples and sugar are premixed in feed bin. Parts of cooker which contact products are of 18-8 stainless steel. Temperature is automatically controlled. —FOOD INDUSTRIES

**Speeds Concrete Pouring**—Time required for pouring concrete is reduced greatly by a 20-ft. long, electrically powered, portable conveyor with 12-in. belt impregnated with Balta gum. Built by American Conveyor Co., it can be used in tandem on large projects and will handle many building materials. —CONSTRUCTION METHODS

**Flails Path for Power**—Right-of-way for power lines is cleared by a new flailing machine. Flails on a drum rotated at 800 rpm. as tractor moves at a walk disintegrate stalks and roots of shrub growth and 4-in. trees 25 ft. high. Refuse need not be burned because it deters regrowth. Bushwacker, Inc., has operated machine experimentally for 2 yr. —ELECTRICAL WORLD

# NEW PRODUCTS



**QUICK TREE CUTTER**—Self-propelling, gasoline-driven, one-man, rotary saw on wheels has been introduced by Harry A. Lowther Co. Saw has mercury-filled centrifugal-action clutch, aircraft-type wheel and axle design, and a friction drive from engine. —CONSTRUCTION METHODS

**Positioning Control**—Composed of three parts—master control stations, followup device (selsyns or potentiometer), and an electronic control—new General Electric Co. positioning control system can be used on drives up to 1½ hp. Driving motor is not included, but any ac. or dc. motor that will handle load can be used. Dial adjustment moves load. —ELECTRICAL WEST

**Reduces Static on Plastic**—Anti-Static Compound 79 reduces or eliminates static on plastic sheets or molded parts, cutting dust accumulation. It is a development of Merix Chemical Co. —AIR TRANSPORT

**Speedy Die-caster**—With pushbutton initiated cycle, an automatic zinc, tin, and lead die-casting machine introduced by Wickes Bros. opens and closes dies at 750 ipm., with momentary slow-down just before closing. Electric timers control machine, but any part of cycle can be operated manually. Maximum capacity is 100 cu. in. —AMERICAN MACHINIST

**Hazardous-area Motors**—For use in inflammable atmosphere, 300-hp., 240-rpm., inert-gas-filled, enclosed synchronous motors are being built by General Electric Co. Enclosure has built-in water-type cooler. Resistance thermometers imbedded in stator windings operate a relay to stop motor if temperature becomes excessive. —ELECTRICAL WORLD

**"Vulcanized" Starch**—Available in experimental quantities from National Starch Products, Inc., Vulca-100 starch is an inert, nontoxic, organic filler resistant to the swelling action of heat, acids, and enzymes. Some potential applications: printing thickeners in textile operations, creams used in cosmetics, electrolyte carriers in dry-cell batteries, and ingredients in various food products. —CHEMICAL ENGRG.

**Moisture Resistant Paper**—Heavy kraft paper saturated and coated with gilsonite, asphalt, and wax can be used as a moisture barrier between sheathing and facing, under floors, or for roof decks. Called Presstite, it has good flexibility, no odor, and does not shrink. It was developed by Presstite Engrg. Co. —ENGRG. NEWS-RECORD

**Pipe Compass**—Lines of intersection of two pipes to be welded together at an angle are accurately marked by a special compass of Martindale Electric Co. Marking arm slides up and down on adjustable center leg which is set at intersecting angle by a protractor. Compass base can be fastened to the pipe by a chain. —WELDING ENGINEER

**Carbonated Coffee**—A process for carbonating a mixture of coffee and cola drink, to be sold by the bottle or at fountains, has been developed by Cola-Moca Corp. The soft drink has been kept in bottles 2 yr. without becoming rancid or precipitating its starchy colloids. —BUSINESS WEEK

**For Precise Surfaces**—Having a range of 0.5 microinch up, the 15-lb. self-contained Pico surface comparator consists of a meter and an exploring head with light, lenses, and photocell. Head is placed on surface and meter reading compared with standards; reading takes 5 sec. Photon Instrument makes the comparator. —AMERICAN MACHINIST

**Protects Aluminum**—New chemical coating which protects aluminum against corrosion has been developed by American Chemical Paint Co. Applied by spray or immersion, it interacts with the metal to form a thin, tough film. —AVIATION WEEK

## FREE SERVICE TO READERS

*As a special service to our readers, McGraw-Hill Digest will furnish, without any charge, additional information about any new product or technical development described in this publication. Inquiries are welcomed. Address your letter to: The Editor, the McGraw-Hill Digest, 330 West 42nd St., New York 18, N. Y., U. S. A.* —*THE EDITORS*

**Quick Runway Conduit**—Six workmen laid 5,760 ft. of 4- and 6-in. dia. spiral tubing in one day under Idlewild airport runways for conduit. Spiral tubing, developed by Pratt Industries, Inc., comes in 30-ft. sections, one end expanded. Telescoped sections were laid on 3-in. concrete mats and covered with a protective concrete layer. The spiral ribs are crush-resistant. —AIR TRANSPORT

**Frozen Fish Bricks**—Frozen filleted fish, packaged like ice cream, can be cut into any shape for cooking. Fish needs no defrosting. It is a product of Atlantic Coast Fisheries Co. —BUSINESS WEEK

**Faucet-powered Dishwasher**—Dishes and pans are washed and rinsed in one operation with the L. K. Franklin Corp. water-powered, hand-operated dishwasher. Water is taken from faucet. Button on head passes water through chamber containing detergent for washing then releases for rinse. Bristles are nylon, brass. —ELECTRICAL MERCHANDISING

**Aluminum-paper Insulation**—Alternate layers of asbestos paper and aluminum foil, which can be built up to any thickness, comprise a new insulation developed by Ric-Wil Co. It is for indoor and outdoor use and for hot pipes. —CHEMICAL ENGRG.

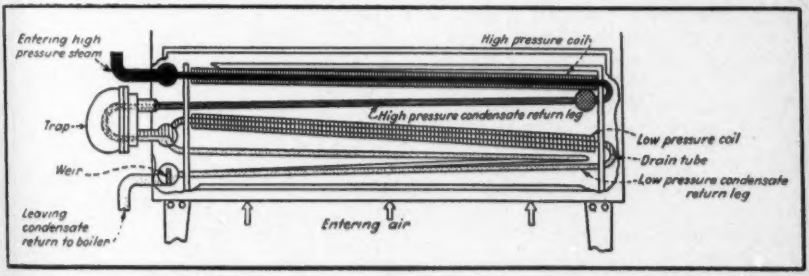
**Spring Nuts**—Exerting strong gripping action on threads, the Diamond G spring nut is used like a conventional nut but resists loosening. Another model acts as a locknut. They are made by G. K. Garrett Co.—POWER

**Cart Climbs Stairs**—Caterpiller-type frame, long enough to span three steps, on the new Menne Development Co. crawler cart permits moving 1,000-lb. loads up or down stairs easily. Dolly is aluminum alloy, frame is tubular; rubber and fabric treads rest on rollers. It weighs 60 lb. —BUSINESS WEEK

**Machine Loads Pallets**—Cases from a conveyor line automatically are loaded onto empty pallets and cross-tied by a new Production Aids, Inc., machine. Cases are placed on a stripper plate in any desired pattern. When each tier is completed, the plate is removed to put cases on pallet, then pallet is lowered the thickness of the case to await next tier. —FOOD INDUSTRIES

**Speed Wheel Service**—Car wheels can be balanced quickly and easily by a new portable, automatic wheel balancer. Wheel is laid on balancer with core on tapered supports. Foot pedal raises ball pivot which suspends wheel on free-swinging pendulum. Spirit level checks balance, weights can be affixed to wheel on tester. It is a George W. Borg Corp. development. . . . Truck rims can be measured without removing tire with the new National Wheel & Rim Assn. aluminum gage. It can be used on all demountable truck rim wheels. —BUSINESS WEEK

**Powdered Stainless**—Stainless-steel powder now is available at reasonable price. It can be formed into filters for corrosive fluids and used in "powder welding" corrosion-resistant joints. —AMERICAN MACHINIST




**EFFICIENT HEATER**—Latent and sensible heat in steam are utilized more completely by dual coil system in new Niagara fan heater. High-pressure steam enters finned coil, and condensate flows into trap from which it is admitted to vapor-coil header. Here it flashes into steam at low pressure and enters vapor condensing coil. Top leg of this coil is finned and steeply pitched; lower leg is relatively level and leads to condensate return header. In this header, a weir keeps liquid level high in lower leg, where liquid is in contact with coldest portion of air stream. Condensate therefore is subcooled below its relative return temperature. Apparatus requires no pressure-reducing stations; live steam is not wasted as in dump-trap or hot-well methods; efficiency is high; condensate is returned in even flow. —PRODUCT ENGRG.

# Flotation Recovers Waste Fuel

**Froth separation process uses light fuel oil and pine oil in reclaiming minus 28-mesh anthracite silt. Eighteen flotation cells used; ash content 14%**

Flotation cells employing air only to make the flotation froth and using light fuel oil and pine oil are utilized by Susquehanna Collieries Co. in its flotation plant recovering and cleaning minus 28-mesh anthracite. About 65% of the 320 tons of feed is recovered in a 7-hr. work day. Ash content has been reduced to 13.91% through use of 18 flotation cells —ten rough and eight final cleaning cells.

Coal carried to top by froth bubbles is removed by rotating froth ejectors into launders leading to a sump. From sump, coal is pumped to dewatering basins. Breaker discharges about 3,000 gpm. of water, the water carrying about 850 tons of material in 7 hr. The coal ranges from No. 4 buckwheat to zero in size.

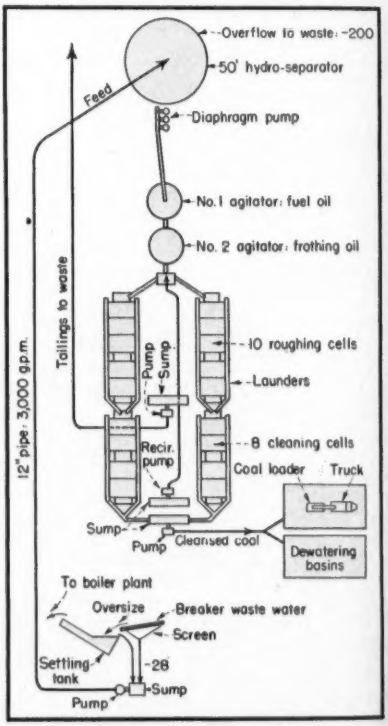
To get No. 4 and 5 sizes separated from the minus 28-mesh in the feed, half of the breaker waste water is run into a 12x40-ft. settling tank, the remainder is run over a high-speed screen, and the water and minus 28-mesh finally go into the same tank. About 230 tons of the material is pumped to the flotation plant, the remaining material going to the power-plant stockpile.

Water carrying minus 28-mesh feed is run into a 50-ft. dia., 10-ft. high Hardinge hydro-separator. Overflow into launder, carrying most of the minus 28-mesh material, flows into a settling pond. The remaining 300-350 gpm. of the 3,000 gpm. is removed from the bottom of the cone and elevated to a flume feeding the main plant. Stroke of the triplex diaphragm pump is adjustable to vary percentage of solids in the water.

Carrying about 40% solids, the water first goes to an 8x8-ft. agitator, where it is mixed with fuel oil. This mixture then enters a second agitator, pine oil being added. The reagent costs average about 7¢ per ton of clean coal. In a small mixing tank, water is added to the mixture—the solid content being about 20%—and this passes to rough then final cleaning cells.

Size 60 Steffensen roughing cells in two banks of five each are followed by two banks of four Size 60 Steffensen cleaner cells.

Air for frothing enters from headers at the top of the plant, hoses being con-




Flow sheet of flotation process.

nected to each cell. Cells require about 850 cfm. of air, this being supplied by a 150-hp. blower.

Tailings from rough cells are pumped to final settling basin, while tailings from cleaner cells are pumped back into mixing box following the agitators.

Clean coal is delivered from cleaner cells to two settling and loading basins. The clean coal has a surface moisture of about 13%. Two men operate the plant, third handles truck loader. —COAL AGE

## SWEPT-BACK WINGS BEST IN SUPERSONIC TESTS

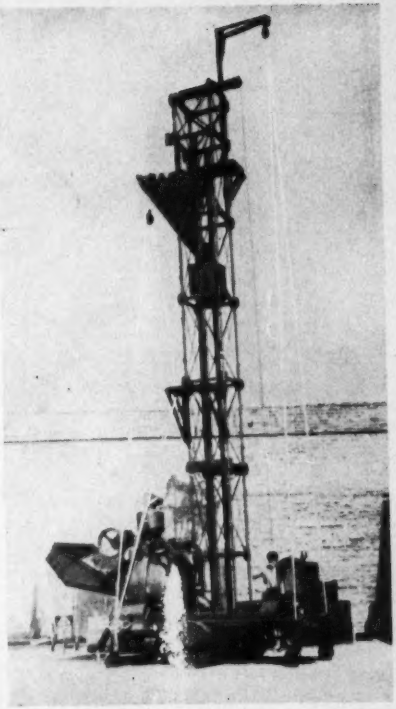
Supersonic engineers expect that some form of swept-back wings will be necessary to negotiate turbulence of the transonic zone. But once transonic speed and control are reached, they expect a return to straight-edged wing design. Tests have been conducted with sweep back up to 83 deg., forward sweep, combinations of forward and backward sweep, triangular Delta wings, and trapezoidal shapes of Ackeret wings.

Currently, best results in low-speed zones were found with swept forward wings, but problems in the high-speed zones indicate that swept-back wings. even with their inherent low-speed problems, will prove most satisfactory. Models have been flown and controlled in wind-tunnel tests with 63-deg. sweep back and aspect ratio of two.

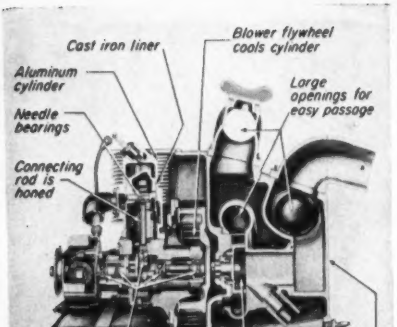
Tip stall characteristics are being countered by attaching small vanes to wing leading edge to block outward flow of boundary-layer air. Increased stability has resulted from setting the wings at a 5-deg. angle above the normal flight path. —AVIATION WEEK

## BOILERS NEED WATERWALLS

Contrary to popular misconception, water walls are not highly vulnerable to contaminated boiler water, and they not only are advisable, but are necessary for reliable service. Heat recovered by radiation in waterwalls materially reduces the temperature of the furnace and of the gas leaving it. Highly concentrated rates of heat input to a limited area of heating surface are prevented. Scale forms in waterwalls and boiler tubes at much lower rates than in a boiler without cooling provision in the furnace. —POWER



**CONCRETE MIXER-ELEVATOR** — Traveling mixer with built-on lift places concrete directly into building forms. Mix is transferred from mixer to top hopper and chute by hoist bucket riding inside sectional tower which can be extended to 65-ft. height. Designed by Ira J. Kuert, rig is self-propelled, and tower can be tilted 10 deg. on uneven ground. —CONSTRUCTION METHODS




**DESIGNED FOR SERVICE**—Simple, maintenance-free construction is designed into compact 95-lb., 15,000-gph., centrifugal pump of Homelite Corp. Large castings are aluminum alloy; one-piece casting serves as pump body and engine mounting. Pump impeller is on engine shaft; four-part shaft seal is replaced easily; replaceable wear plates are inserted between impeller and housing. Rubber tube opens for priming, closes for pumping. Engine is single cylinder, air-cooled, two-cycle type. Piston and cylinder are aluminum, with long-wearing cast iron liner in cylinder. —PRODUCT ENGRG.

## WAX FROM SUGARCANE

A process to extract from sugarcane a hard wax resembling carnauba has been announced by the U. S. Dept. of Agriculture. Juice from cane is treated with lime, then sediment is filtered out. This, used as fertilizer, contains 10% wax. Crude wax is extracted by solvents (petroleums, naphthas, toluenes, or benzenes) and then separated into hard wax and fatty materials by an acetone solvent. —BUSINESS WEEK

## CARBIDE MASONRY DRILLS GAIN GENERAL ACCEPTANCE

Not only does the cemented carbide tipped masonry drill cut four times as fast, on the average, but it lasts up to 50 times as long as conventional drills of the hardest steel. As a result, it has been adopted generally for cutting holes in concrete, brick, tile, marble, slate, plastics, and many other materials. Holes 24 in. deep have been drilled in a combination of brick and concrete by an extended drill shank specially fluted to remove dust from hole.

Carbide masonry drills are used in any rotary portable drill or hand brace, or in drill presses. The more pressure applied, the better the drills work; using a lever to apply pressure is permissible. Dry drilling is usual practice, but a coolant (turpentine, kerosene, or water) often is desirable when drilling glazed tile. —ELECTRICAL CONST. & MAINT.

## MODEL SCHOOL LIGHTING

Best lighting for classrooms was determined by experimental installations at a St. Paul high school. In room measuring 21 ft. 11 in. by 27 ft. 10 in., with ceiling 12 ft. 4 in. high, continuous-row, luminous-indirect fluorescents are installed parallel to window wall, 5½ ft. apart. Two 40-watt, 3,500° white lamps per 4-ft. section give 42 footcandles.

Ceiling is painted egg-shell color, with 80% reflection. Front wall and side wall opposite windows are dove gray, with 50-55% reflection. Rear wall is yellow and window wall blue, reflecting 50%. Sides of door are painted deep red to rest the eyes. —ELECTRICAL CONST. & MAINT.

## PRINTED CIRCUITS PRACTICAL

Moving rapidly out of experimental stage, printed radio circuits soon will be used in interstage audio couplers employed by at least two receiver manufacturers. Television receiver subassem-

blies using printed circuits are likely to be seen, and one manufacturer plans an extremely small personal radio almost entirely void of conventional wiring and components. —ELECTRONICS

## ANTHRACITE GASIFIED WITH OXYGEN AND STEAM

Rice- and barley-size anthracite coal can be gasified in stationary fuel beds using oxygen and steam, at rates 100% or more higher than for air and steam. The gas produced is suitable for use in ammonia, methanol, or gasoline synthesis. The composition of raw gas produced from the rice coal more closely approaches the composition desired in purified synthesis gas than that reported for operation with large coke.

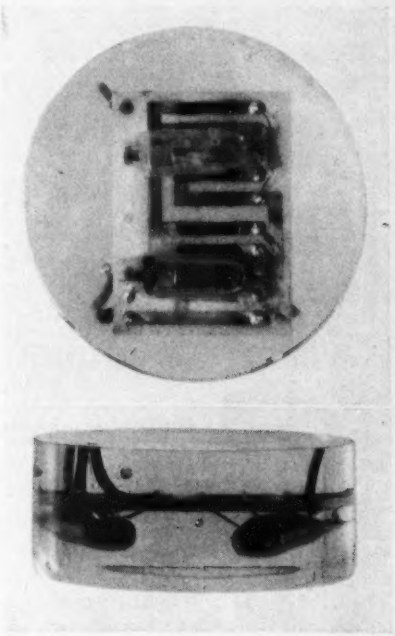
Coal consumption per M cu ft. of raw gas was 23.2 and 25.9 lb., respectively, as fired for oxygen gasification of rice and barley anthracite, lower than for large coke. —CHEMICAL ENGRG.

## ULTRASONIC LAUNDERING

Ultrasonic vibration has been used experimentally to launder fabrics by British Launderers Research Assn. Whereas dirt loosened by soap may not be rinsed away, ultrasonic vibration not only overcomes electrical charges holding the particles but also forces the particles from the fabric. The new technique is more effective and quicker than conventional washing. —ELECTRONICS

## FILING BECOMES SPECIALTY

Importance of specialized record clerks in offices cannot be minimized. Too frequently this all-important business function is performed by stenographers and clerks untrained in filing procedure. Filing has become a basic tool of management and must be carried out by competent personnel. In both government and industry, record management sections are being formed as separate departments, taking them out of the purely service category. Personnel for such work must be screened carefully as to skill and general knowledge. Accuracy is the primary consideration.—*"Records Management and Filing Operations," McGraw-Hill Book Co.*



**POTTED IN PLASTIC—Electronic circuits can be embedded in casting resin to stabilize electrical characteristics and provide protection against vibration and deteriorating atmospheres. Printed and subminiature circuits can be suspended in the resin by first allowing portion to set so that it will support circuit, then completely filling mold. National Bureau of Standards has developed a new potting resin with low electrical loss, high rigidity, and a viscosity permitting penetration of openings. Low shrinkage avoids high pressure on circuit. Vacuum tubes can be protected by rubber jackets in potting. —ELECTRONICS**

# ION EXCHANGE

**Recent developments have significantly broadened the scope of ion exchange until it virtually represents a new tool for the process industries. Used to remove impurities from a liquid, it has wide application in water treatment,**

**—REPORT TO**

**FROM SMALL packaged units . . .**

PURIFICATION of liquid by interchange of ions between liquid and a solid is being investigated in countless laboratories and pilot plants throughout industry, and it already is used commercially for many purposes. Applications include water and boiler feed water, sugar, fruit waste, milk, whiskey, chemicals, and pharmaceuticals.

While ion exchange has been known in principle for a century and used in softening water for 40 yr., it has become important for non-water uses only in the last 10 yr. Key to its present importance was the discovery in the mid 1930's that various types of organic materials possess ion exchange properties. Up to that time only the siliceous zeolites were used, permitting base exchange between metallic cations only. The organic exchangers made possible the exchange of hydrogen ions and led to the development of acid adsorbent resins. Complete deionization of solutions became a commercial reality and opened the way to a whole new field of applications.

### Applications

**Sugar**—Taking the spotlight now are the sugar and related industries, where a dozen or more pilot plants have been operated and where commercial units costing nearly a million dollars each are under construction. Increased yields of sugar and improved quality of residual molasses have seemed to justify investments.

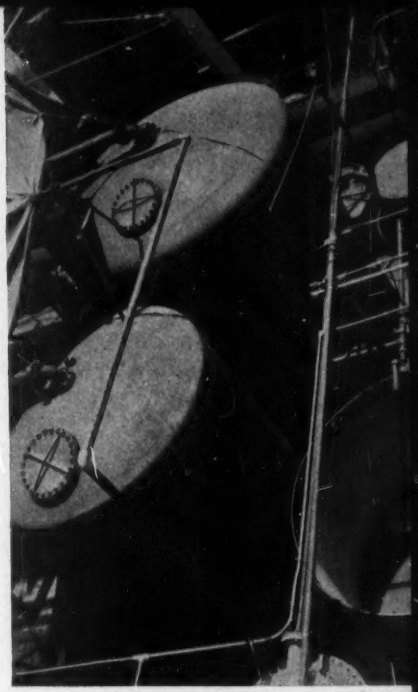
**Water**—Treating, water, however, still is the largest user of ion exchange. Demineralized water—chemical equivalent of distilled water—can be produced at a fraction of the cost of distilled water. Plants range in capacity from a few gallons to more than 40,000,000 gal. per day.

**Whiskey**—There are many other applications. By use of an acid adsorbent resin, formic acid is removed from formaldehyde without adding objectionable salts. This permits higher catalytic reaction rates to improve yields of formaldehyde. To achieve artificial ageing, green whiskey is passed through a deionizing unit and then through a bed of activated carbon. Dissolved salts, free acids, and some colloidal material are removed to achieve improvements in taste and odor. This

# —A NEW TOOL

**will reduce sugar refining costs, and is proving beneficial in chemical and pharmaceutical plants. Principles, technology, and applications are presented in this report, digested from Chemical Engrg.**

## MANAGEMENT—



TO LARGE engineered installations.

application is so recent that its value has not been fully established.

**Textile Wastes**—Metals can be recovered from dilute solution, and Germany reclaimed copper from cuprammonium textile wastes. On a large scale, this process used a cation exchange resin to adsorb the copper ammonium complex ion which, after regeneration, is processed to copper sulphate and reused in the process.

**Pharmaceuticals, Chemicals**—Used extensively by pharmaceutical and fine chemical manufacturers, ion exchange has a part in a number of processes. One such application is in the production of streptomycin, where it is necessary to neutralize without adding further salts to the solution. This is accomplished by acid adsorption in a unit containing anion exchange resin. In a subsequent step in this same process, the streptomycin is converted from the sulphate salt to the hydrochloride.

Use of ion exchange resin as a selective adsorbent in the separation of amino products is being intensively studied. Preferential adsorption may occur because of specific properties of the resin and the ionized particles in solution. Differences of ionization strength will cause one ion to displace another. Thus it will be possible to separate compounds not heretofore readily separated.

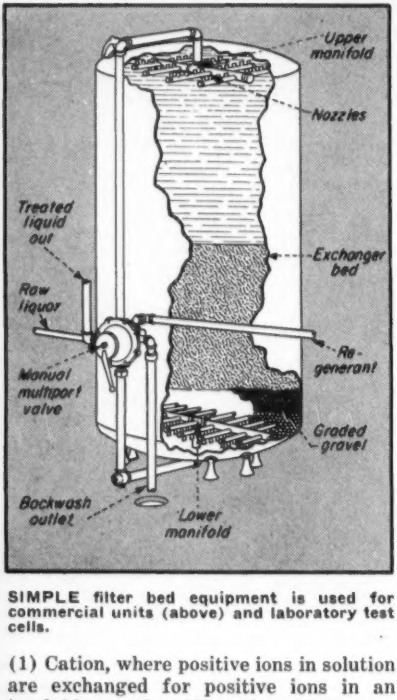
Isolation of glutamic acid is being worked on extensively. Pilot plant operations have been successful and a commercial unit is planned. Lycine, histidine, and argenine are being produced commercially by this means.

**Milk and Pectin**—There are many other pilot plant and commercial-size installations. Some of these include recovery of alkaloids, removal of sulphuric acid from sulphonated oils, reduction of calcium content of milk for infant feeding, recovery of pectin from grapefruit peels, removal of acid from dextrose, removal of sulphuric acid from ethylene glycol, and in processing sorbitol.

### What It Is

Ion exchange may be defined as the reversible interchange of ions between a liquid and a solid involving no appreciable change in the structure of the solid.

There are two types of ion exchange:




**SIMPLE filter bed equipment is used for commercial units (above) and laboratory test cells.**

(1) Cation, where positive ions in solution are exchanged for positive ions in an insoluble matrix. (2) Anion, where negative ions in solution exchange with negative ions of an insoluble solid, or where acids in solution are adsorbed in an insoluble form on the solid. Reversibility makes it possible to restore the original ions of the exchange material after its activity has been exhausted, so that it may be reused innumerable times.

### Materials Used

There are two general classes of commercially used ion exchange materials, inorganic and organic. Inorganic cation exchangers are complex aluminum silicates known as zeolites, widely used for water softening.

Most important in today's ion exchange operations are the organic exchangers. These fall in two classes: (1) "Carbonaceous zeolites," which are cation exchangers obtained by the sulfonation of coal or other natural organic materials. (2) Synthetic resins for both cation and anion exchange. Cation resins are phenol-formaldehyde, and sulfonic acid derivatives, while anion resins are amine derivatives of either aromatic or aliphatic resins. The cation exchangers utilize ion active groups such as $-SO_3H$, $-COOH$, $-OH$, and $-CH_2SO_3H$. All anion exchangers depend upon the $-NH_2$ group.

Organic cation exchangers may be regenerated with acid to operate in the hydrogen cycle, or they can be regenerated with salt to operate in the sodium cycle. From the standpoint of physical structure, ion exchangers are extremely insoluble porous materials whose walls contain a high percentage of tightly bound exchange groups. In appearance, they are granular solids in sizes ranging from 10 to 70 mesh and may vary in color from white to black. Densities of organic exchangers range from 30 to 50 lb. per cu. ft. One cation exchanger is in spherical particles of 12-40 mesh.

Perhaps the most important point relating to synthetic ion exchangers is the possibility of varying the properties by varying the synthesis of the resin. Thus ion exchange resins may be developed for specific purposes.

### Equipment Needed

In general, ion exchange is carried out at relatively low temperatures. One manufacturer recommends that cation exchangers be used at temperatures below 140°F. and anion exchangers below 110°F.

Since ion exchange involves reaction between a liquid and a solid, the primary function of the equipment used is to bring reaction components into intimate contact so that exchange of ions may take place. The most common procedure is to pass the liquid through a bed of ion exchange granules.

Normal operating cycle includes four steps: (1) Reaction between exchange

bed and raw liquor. (2) Backwash of bed to remove foreign matter and regrade bed. (3) Regeneration of exhausted exchanger by passing regenerant solution through the bed. (4) Rinsing bed free of regenerant. The bed is then ready for the next cycle. Three units usually are provided. At a given time, one is on stream, one being regenerated, one ready for operation.

All equipment is of more or less standard design. Each unit, either for cation or anion exchange, consists of a cylindrical tank or column containing a bed of ion exchanger supported on a false bottom or on built-up layers of graded gravel, quartz, or similar material. A collector device is built under the false bottom, while a system for distributing the raw liquor and regenerant is installed above the exchanger bed. External piping handles the flow of liquor, regenerant solution, backwash, and rinse water.

### Water Treating Process

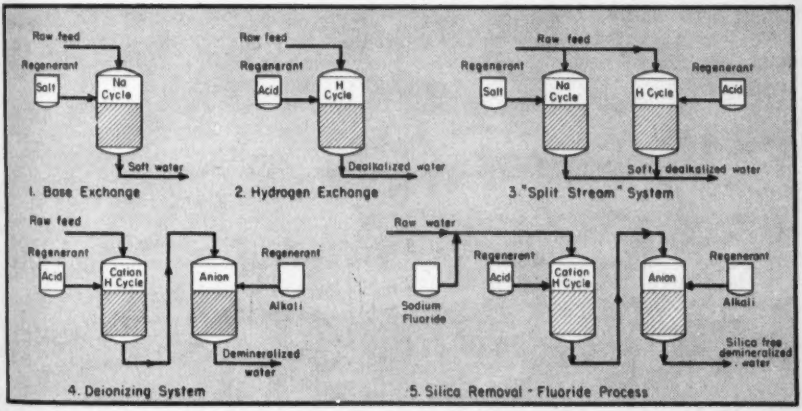
Operating in the hydrogen cycle, an acid regenerated cation exchanger removes Ca, Mg, Na, and Fe while converting the chlorides, sulphates, nitrates and carbonates to their acid derivatives. Effluent then is acid to the extent of the hydrogen ions required to replace metallic ions. Acids thus formed can be neutralized sufficiently by (1) blending with raw water, (2) by so-called "split stream" method of blending with water softened in the sodium cycle, or (3) by removing the acids in an anion exchange cell. In any case, it is necessary to remove the $CO_2$ (from the carbonic acid) in a degasifier.

### Boiler Feed Water

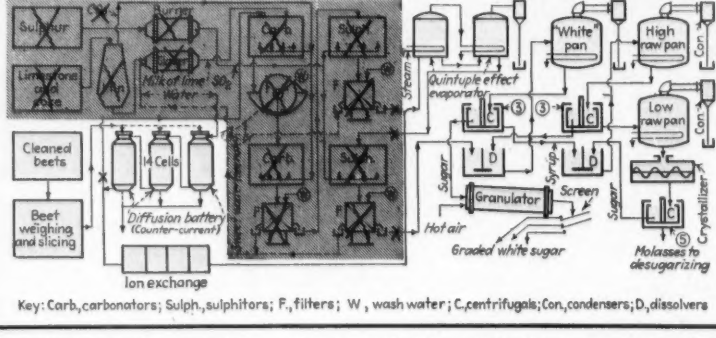
Most significant development in water treatment is removal of silica by ion exchange, significant in treating boiler feed water.

To accomplish the silica removal, sodium fluoride is added to the raw feed entering the cation exchanger where it is converted to hydrofluoric acid. This reacts immediately with the silica to form fluosilicic acid, subsequently adsorbed by the anion resin. Final concentration as low as 0.5 ppm. $SiO_2$ can be attained. The anion exchanger must be rinsed with acid to flush out residual fluosilicic acid before regenerating with caustic.

A number of plants under construction are expected to provide silica-free boiler




**BASIC HOOKUPS used in treating water represent bulk of ion exchange installations.**




Key: Carb., carbonators; Sulph., sulphitors; F., filters; W, wash water; C, centrifugals; Con., condensers; D., dissolvers

**PROFITS** in beet sugar will come from substituting deionization for present methods.

feed water in capacities up to nearly 3,000,000 gal. a day. Cost of this method is said to be relatively high.

### Sugar Refining Process

It is in the sugar industry that most intensive efforts have been made to utilize this new process tool. With ion exchange treatment, 95% or more of total sugars can be recovered as white sugar from cane or beet juice, against 83½ to 85% by standard methods. In addition, the remaining molasses is a pleasant tasting sirup. Important from the operating standpoint, removal of substances such as calcium improves heat transfer by eliminating scaling of equipment. Although the primary purpose of deionization is to remove mineral electrolytes, the treatment can take out 60-90% of the organic nonsugar solids.

In the long run, the real value of ion exchange will be the elimination of some of the process steps. Most activity now is in beet sugar, and ion exchange units have been used to treat the juice at various points in the refining process. Most desirable, economically, would be to deionize diffusion juice directly and then pass it to evaporators. This would eliminate the carbonation and sulphitation steps and save materials and labor.

One commercial ion exchange plant built for beet sugar consists of four cation and four anion exchange cells, each 12 ft. in dia. and 12 ft. deep, with resin bed 5 ft. deep. Only one pair of cells is on stream at a given time.

Major operating cost is for regenerants. Generally, 15-25 lb. of 66 deg. Bé sulphuric acid per ton of beets is required, and about 5 lb. of anyhydrous ammonia per ton of beets is needed to regenerate the anion exchanger.

It takes about 1 cu. ft. of each exchange resin per ton of daily capacity, and operation losses run up to 15% per campaign of 1,000 cycles.

Work is under way to recover more than 4,000 tops of sirup annually from unpotable pineapple juice in Hawaii. Similarly, a plant is operating in Florida to recover sirup from waste citrus peel press juice. In both operations, citric acid is produced, and a number of organic byproducts will be recovered.

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**A PARTIAL LIST OF MACHINE TOOLS FOR SALE**

*by War Assets Administration*

**BORING MACHINES,** Horizontal Precision Bridge Type, Single and Double End. (finishes holes and other surfaces)

**CHUCKING MACHINES,** Single Spindle, Automatic, Horizontal Turret Type. (bores, rounds and threads metal stock)

**DRILLING MACHINES,** Bench or Floor Model, Single or Multiple Spindle. (drills various size holes)

**FORGING HAMMERS,** Cecostamp (forms, bends and stamps sheet metal)

**GEAR CUTTING MACHINES**

**GEAR SHAPERS** for spur and helical gears, external and internal (cuts precision gear teeth)

**GRINDERS,** Internal and External, Cylindrical

**GRINDERS,** Surface (rotary table type)

**LATHES,** production type (manual, semi-automatic and automatic)

**MILLING MACHINES,** Automatic and manufacturing knee type (makes straight cuts across metal surface)

**MILLING MACHINES,** Bed Type (horizontal and vertical—certain sizes only)

**POLISHING AND BUFFING MACHINES** (double end)

**PROFILING MACHINES,** Vertical Fixed Bed Type (mills odd shapes)

**SCREW MACHINES,** Multiple Spindle Bar Type Automatic

**SHAPERS AND SLOTTERS,** Vertical

**SPEED LATHES,** all types and sizes

**TAPPING MACHINES,** Vertical, single or multiple spindle (threads holes)

**THREAD GRINDING AND THREAD MILLING MACHINES**

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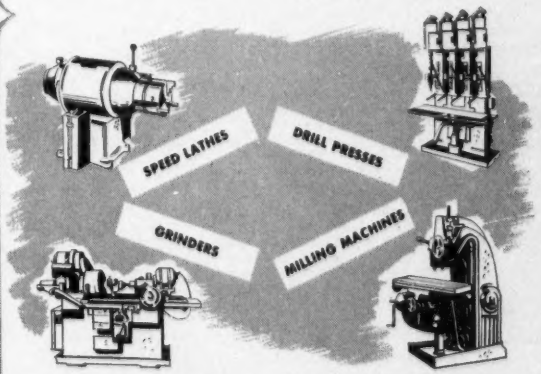


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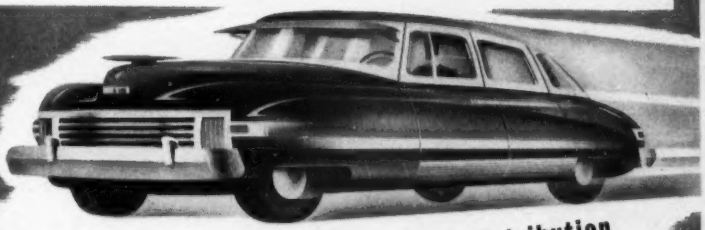

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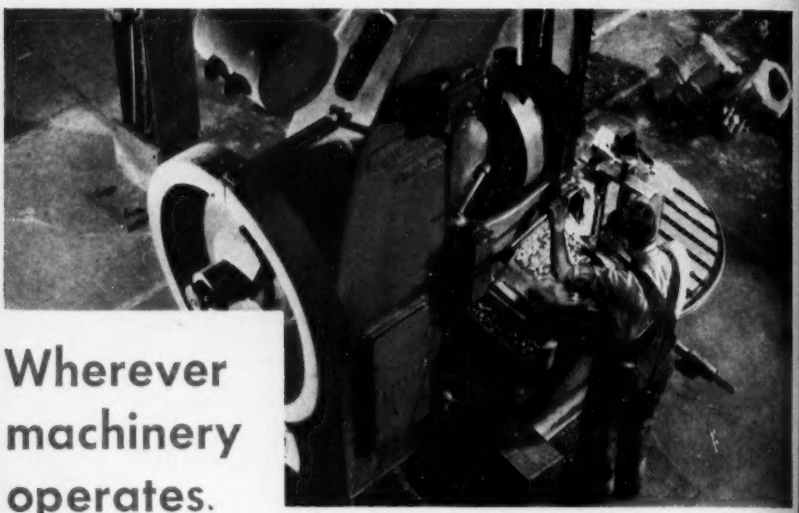

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